

SCIENTIFIC AMERICAN

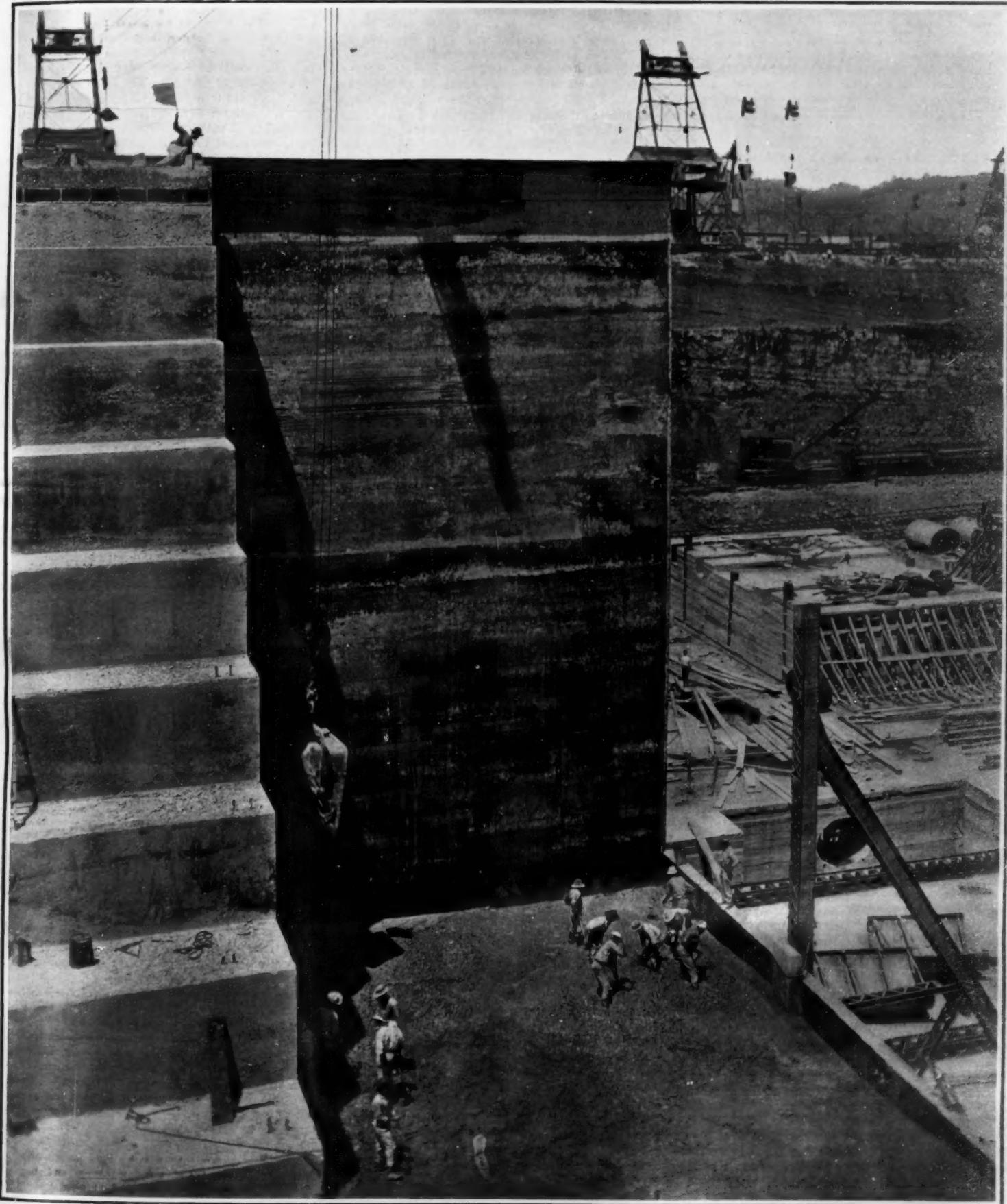
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The side walls, 2800 feet long, are built in sections between plate steel forms. To the right of the completed wall is seen the interior face of a steel form, with the form for the end of the section upon which the men are at work extending transversely. In the pocket thus formed the men are shoveling and tamping the wet concrete.

BUILDING THE HUGE WALLS, 50 FEET THICK AND 88 FEET HIGH, OF THE GATUN LOCKS AT PANAMA.—[See page 279.]

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NEW YORK, SATURDAY, APRIL 2nd, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE PANAMA CANAL AS AN INVESTMENT.

CONSIDERABLE doubt is being expressed just now as to whether the Panama Canal will prove to be commercially a paying investment, and in a series of articles, which have recently been published, Admiral Evans, proceeding along several rather formidable lines of argument, is apt to leave, at the first reading, a depressing conviction that this great national undertaking can never be self-supporting.

On the other hand, there is the fact that other great canals, such as that at Suez and the one which has made Manchester a seaport, were, during their construction, the subject of similar dismal forebodings. Yet Suez has proved to be one of the most profitable commercial undertakings in the history of the world; and the Manchester enterprise, in spite of the few lean years of its earlier operation, is now accomplishing all and more than was promised.

It is well to remember, moreover, that the admiral's pessimistic view of the future is based upon a comparison of the sailing distances between certain trade centers *via* the two canals, and he assumes that unless the distances *via* Panama are shorter than those over the present routes, the new waterway will be powerless to divert existing trade from its present lines of sailing. Now, although the principle as here laid down is broadly correct, it should not be forgotten that the connecting of the two great oceans is certain to materially affect the trade conditions along the whole stretch of both the Atlantic and Pacific seabards of North and South America. Indeed, the cutting of the canal may so enlarge the trade and importance of certain of the maritime cities as to render it expedient for shipping which at present uses the Suez Canal route to take the longer route by way of the Panama Canal.

But we should judge of the value of the Panama Canal rather from the military than the commercial point of view—a fact which is well understood at Washington, where undoubtedly it acted as the compelling motive in urging Congress to undertake this stupendous work. That 14,000-mile trip of the battleship "Oregon" during the Spanish war was an object lesson, the significance of which has never been forgotten. The opening of the canal will render the whole naval force of the United States available in either ocean. In its ability to strike a rapid and decisive blow at any threatened point along the whole of the United States seaboard, the efficiency of our fleet will be practically doubled; and the fact that the whole navy can in a few week's time be assembled in the Pacific Ocean will enormously increase the naval prestige of the United States in the Orient, and must inevitably tend to preserve the peace in those great Oriental questions which begin to loom so large on the diplomatic horizon. So long as the Isthmus of Panama exists as a barrier between the Atlantic and the Pacific, we must build at least three battleships where otherwise we would build two, and the first cost of construction and the heavy cost of maintenance and operation will far exceed any temporary or even permanent deficit which may develop in the operation of the canal as a commercial venture.

Meanwhile, under the administration of that most efficient body, the Corps of Engineers of the United States Army, the execution of the work is proceeding with a rapidity which is in pleasing contrast to the confusion and disappointment which marked the earlier years of American occupancy; and in the series of striking illustrations of the work, which we present in the present issue, we are enabled to give our readers an adequate impression of the magnitude and solidity of the permanent works, the most monumental concrete structures ever attempted.

Scientific American

RELATIVE REPAIRS ON NAVY-BUILT AND CONTRACT-BUILT SHIPS.

THE wisdom of the policy of building at least a small portion of the new ships of the navy at our leading navy yards has been and is yet a question upon which there is much division of opinion. The principal argument in favor of this policy is that it becomes possible to maintain an adequate force of skilled mechanics permanently at the yards, and avoids that disastrous breaking up of the organization and scattering of forces which occurs in the slack season, when the annual repairs upon the ships are completed and they have sailed for the summer maneuvers. The maintenance of a permanent force increases efficiency and insures that the leading yards will be in a position to meet at once the heavy strain which would be thrown upon them in the event of sudden hostilities. Of equal importance to the question of the effect of new construction in maintaining a permanent force in the navy yards is that of the character of the work that they can turn out. Conclusive data upon this subject are furnished by those two sister ships, the "Connecticut" and the "Louisiana," the first built at the New York navy yard, and the latter by the Newport News Shipbuilding Company. If certain disabilities under which the navy-built ship labored, due to slowness in the delivery of armor and the fact that she required special fittings as a flagship be considered, the time and cost of construction may be regarded as approximately the same as those of the ship built by contract.

As to the question of the relative quality of the work done, there is no surer test of this than the amount of repairs which have been made upon each vessel in the four years that they have been in commission. The following figures, taken from the report of the Paymaster-General of the Navy, are very conclusive on this point. In 1906, their first year of service, the repairs on the "Connecticut" cost \$236.97, and on the "Louisiana" \$5,851.09. In 1907 the repairs on the "Connecticut" amounted to \$53,557.47, and on the "Louisiana" to \$9,851.09, and the totals up to the end of the fiscal year 1909 were, for the navy-built ship, \$111,833.58, and for the contract-built vessel, \$149,167.

In view of the fact that, during these four years, the cost of the repairs for the "Connecticut" was about 33 per cent less than that of the "Louisiana," what becomes of the oft-repeated statement that our navy yards are incapable of turning out work of the same high quality as that of our private yards?

THE NEED OF AN IMPROVED PARCELS POST.

THE existing restricted parcels post system of the United States Post Office, as established by Congress in 1874, has so far limited the easy exchange of commodities and merchandise between manufacturers and consumers that it is making the United States appear to be wonderfully behind the times as compared with some foreign nations, such, for instance, as England, France, and Germany. It is a fact to-day that an American in England can send home by mail to any part of the United States a parcel weighing two and one-half times more than the United States limit for about one-third less in cost than the present home rates. In other words, the world postal union package unit is eleven pounds to the parcel at the rate of twelve cents per pound. Whereas the United States unit is only four pounds to the package at a cost of sixteen cents to the pound. The parcel rate in the United States prior to and early in 1874 was eight cents per pound for a package limited to a weight of four pounds. After that the rate was doubled, but the weight remained the same. Since 1874 the cost of transportation has greatly decreased. The question is, why should not the public through its representatives in Congress be given the benefit of this decrease by the establishment of a uniform low postal rate for parcels that will encourage the use of the Post Office as a medium of exchange of commodities, and thus greatly facilitate trade?

Since the experimental introduction of the Rural Free Delivery system in this country, its operation has proved so great a necessity, convenience and success that Congress overlooks the annual deficit arising from the unreasonable restriction placed in the law limiting the kind of postal matter to be carried to letters, newspapers, and periodicals. The weight of this average load is ascertained to be but twenty-five pounds per trip, while the vehicle which the postal agent is required to supply can readily carry two hundred pounds. It is estimated that should the restriction be removed and parcels be carried, even allowing only one or two parcels per trip, enough revenue would be received from the additional postage to more than pay the total cost of this system, and make it self-supporting.

A movement in this direction is the introduction of a bill before Congress, prepared by the Postal Progress League, known as the Bennett Rural Parcel Post Bill, now in the House Postal Committee, which provides

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for very moderate postal local rates along rural routes between the city or town and places in the adjoining country. It would enable the merchants in the commercial center to send, say on telephone orders, small supplies directly to the purchaser living on the route, and would promote the exchange of merchandise between the residents themselves on the route, as well as their sending products to the commercial center; the service would be somewhat similar to that of the usual postal railway coach and its collection and distribution of mail matter.

With the extension of good roads and the use of rapid automobiles, a longer route could be established than now exists, as a maximum distance; which would reduce the number of vehicles required and economy the cost of maintenance.

In this connection the experience of the use of the mail automobiles in London is worthy of note. At the second annual dinner of the Royal Automobile and Associated Clubs of London in the summer of 1909, Sir Henry Norman in a speech alluded to the success of the mail automobile as a time and money saver in the transportation of mails, by saying that in the city there were thirteen local motor services averaging thirty-two miles a day. There were also ten sets of services in and out three times a day between London and the principal towns on the outskirts of the city. In the thirteen long-distance night automobile mail coach services a saving of \$300,000 a year was effected as compared with the horse service which did the same work only a few months before. The London Post Office is now operating no less than sixty of these motor services.

Results of this character certainly show that the establishment of a very low postal rate for parcels is feasible, since it will create more than sufficient revenue to pay the cost, besides saving money for the merchant and consumer.

It is to be hoped that Congress will give such intelligent consideration to all matters relating to postal improvement that the system, so useful and necessary to the people, will forthwith be placed upon a sound business basis.

HYDRAULIC TURBINE REDUCTION GEAR.

IN the issue of the SCIENTIFIC AMERICAN of February 12th of the present year, we described the turbine reduction gear designed by McFarland and McAlpine, in which a mechanical gearing is interposed on the shafting between the turbine and the propeller, for the purpose of reducing the economical high speed of the former to the relatively low economical speed of the latter; and it was noted that a mechanical efficiency of 98.5 per cent had been secured in the shop tests. Simultaneously with the development of this gear, the problem was attacked by Dr. H. Föttinger, who, with the assistance of the Vulcan Works at Sefton, has produced a reduction gear, which substitutes for the toothed gear of the McFarland system a set of hydraulic turbines, through which a body of water is kept in constant circulation, and by the proper proportioning of whose buckets and channelways the desired reduction of speed is secured. A complete description of this gear with illustrations is given in the current issue of the SUPPLEMENT, to which reference is made for fuller details than are here given. The turbine shaft and propeller shaft are independent. Upon the former is mounted a rotary pump, which delivers its water into the buckets of a water-wheel which is mounted rigidly upon the propeller shaft; and it will be evident that by selecting the proper relative dimensions of the two members, the desired ratio of speed between turbine and propeller can be obtained. In its simplest form the reduction gear consists of a pump, guide channels, and a driven water-wheel; but in the larger powers one or more intermediate wheels would be interposed between the pump and the driven wheel; indeed transformers with one or more stages are preferable when a considerable reduction of speed is desired. With a reduction ratio of between 1 to 4 and 1 to 6, using two reduction stages, an efficiency of from 80 to 82 per cent is secured. This seems low when compared with the 98.5 per cent efficiency of the McFarland gear; but the German system has the advantage that it is readily reversible. The system has been tried on a small vessel of 76.7 tons, which has been driven by a 500-horse-power turbine at a speed of between 13 and 13 knots. When the reversing lever was thrown over at full speed, the propeller shaft came to a standstill in 5 seconds, and within 15 seconds had acquired a reversed speed of between 200 and 250 revolutions. On the whole, it would seem that the German, because of its low efficiency, cannot compete with the American system on ships that make long continuous voyages. On channel and river steamers and for tugs and small vessels it has some advantages.

Asbestine, for Fireproof Coatings.—Prepare a paste-like mass of asbestos, powdered silica, caustic potash, and soda-water glass. To be burned and sand mixed with it.

ENGINEERING.

Again the trans-atlantic record has been broken, this time by the "Mauretania," which reduced the long Atlantic course of 2,889 miles by 26 minutes, making the passage from Daunt's Rock to the Ambrose Channel Lightship in 4 days, 15 hours, and 29 minutes, at an average speed of 25.91 knots.

The great value of the steel car as a protection to passengers in the event of collision was demonstrated in a recent clash of two trains in the Hudson tunnel. There was no such telescoping as would probably have occurred with wooden cars, and the injuries were merely such as resulted from the passengers being thrown down by the shock of the collision.

A recent issue of *Cassier's*, states editorially that the first British steamboat was not Bell's "Comet," which ran on the Clyde in 1811, but the "Accommodation," which commenced running between Quebec and Montreal on the St. Lawrence River on November 5th, 1809, or two years after the "Clermont" made her official run from New York to Albany. The first steamers on the Lakes were the "Ontario" and the "Frontenac," which appeared in 1816.

A French naval constructor, basing his deductions on the recent French maneuvers, believes that the future submarine will be a "submersible destroyer" of 20 knots surface and 15 knots submerged speed, of sufficient radius of action to accompany the main fleet on long cruises. He believes that the greater the radius of action and the higher the submerged speed, the nearer will such a vessel approximate a perfect underwater instrument of offense and defense.

Some tests of the effect of superheating recently made on the American yacht "Idalia" show striking results. When using saturated steam, the consumption of water per indicated horse-power was 18.3 pounds. This was reduced to 17 pounds, with 57 degrees of superheat, 15.8 pounds, with 96 degrees, and to 15.5 pounds, with steam at 105 degrees superheat; this last being a saving of 15.3 per cent of steam, a truly remarkable showing. The trial with saturated steam was of two and one-quarter hours duration, and with 105 degrees the test lasted for three hours.

A report of the Public Service Commission, relating to the delays of passenger trains in New York State during December, shows that 60,385 trains were run, of which 75 per cent were on time at division terminals. The average delay for each train was 39.7 minutes, and the proportional causes of delay were: Waiting for trains on other divisions, 40.9 per cent; waiting for train connections with other roads, 14.4 per cent; train work at stations, 12.2 per cent; trains ahead, 8 per cent; meeting and passing trains, 4.8 per cent; engine failures, 4.3 per cent; train wrecks, 3.8 per cent.

An experiment which is being tried on the Hudson and Manhattan Railroad tunnel system beneath the Hudson River will be watched with much interest by both the railroads and the public. It consists in illuminated station signs, placed inside the cars, which are so arranged that the guard, by pressing a button when the train starts, rings a bell and causes the sign to display the name of the next station. This sign continues to be displayed until the train leaves the station designated. A simple device, this, whose utility is so obvious, that it should have been in use from the very commencement of electrically-operated rapid transit.

A commission of engineers and scientists is making an exhaustive study of the causes of the recent flood in Paris, preparatory to devising a system of protective works which will absolutely prevent any recurrence of the disaster. The main work of the commission will be to devise a plan for keeping the river Seine within its banks either by the construction of higher embankments or by the provision of a by-pass channel to carry the surplus waters around the city. At the same time the commission will investigate the various public services, including surface and subway lines and the sewer, gas, electricity, telegraph, and telephone systems which were affected by the inundation, with the object of remedying the defects which were developed during the flood.

The work of providing adequate coast fortifications has been carried to the point at which they may now be considered to be very complete, at least as far as the guns and emplacements are concerned. The full efficiency of these fortifications cannot be realized, however, because of the lack of proper submarine mine equipment and the proper accessories for the mines and guns already installed, such as fire control apparatus, searchlights, power plants, and adequate ammunition. The Chief of Coast Artillery says: "Without these accessories the \$70,000,000 already expended would be wasted, since the guns would be of no more value in the defense of the forts in which they are mounted than so many dummies." To make this provision will require about \$15,000,000.

ELECTRICITY.

As the Glidden tour this year will pass through territory where the telephone and telegraph service is very poor, it has been decided to equip the cars with wireless telegraph apparatus. This will make it possible to keep in close touch with the contestants, and the latter will be able to report accidents and call for help when necessary.

In plants which use a gas engine to drive their generators the variations in speed of the engines are not noticeable if carbon filament lamps are used, because the filament is quite thick and does not respond quickly enough to show any fluctuations in light. With tungsten filaments the light wavering is very annoying, and gas-engine manufacturers have found it necessary to equip their engines with heavier flywheels.

A convenient method of determining variations in the candle-power of a lamp was described in a recent number of *Elektrotechnische Zeitschrift*. A selenium cell is employed, which is exposed to the lamp under test and is placed in series with a recording milliammeter. The curve recorded by the milliammeter, which is due to the variable resistances of the selenium cell, indicates the variation of the candle-power of the lamp. To be sure, this does not give an accurate photometric measurement.

A large section of land has been bought by the Commonwealth Edison Company in the northwestern part of Chicago, where two large generating stations are to be built. Each station will be equipped with six turbines, and in the first station the capacity of each turbine will be 30,000 horse-power. It is expected that within two years 60,000 horse-power will be in operation. These stations are made necessary by the fact that the output of the company has doubled every three years for the last twelve years.

Chicago is trying a new car designed to remove city garbage over the street railways at night. The car is of steel construction, 34 feet long, divided into three sections which are so shaped that they can be dumped with a pole by a single man, thus doing away with the necessity of using air cylinders or other mechanical dumping apparatus. The sections are made watertight, so that there will be no leakage of wet garbage. The car is not provided with motors. It is intended to use the car in the daytime for hauling concrete and construction materials.

A novel method of recovering a sunken cargo has been adopted by the United States Steel Company. A large magnet, 3½ feet in diameter and weighing 3,000 pounds, has been employed in raising kegs of nails from a barge that was sunk in the Mississippi River near New Orleans. The magnet raised five or six kegs at a time, or about a ton at each lift. The advantage of this method was that it avoided breaking open the kegs, as would have been the case had a dredge been used. The magnet is soon to be used for raising a sunken load of woven wire, and also for a load of steel baling strips.

Several years ago the Illinois traction system decided to use sleeping cars between Springfield and East St. Louis. As this system has proved a success, several more cars have been ordered for use between St. Louis and Peoria. These cars will differ from the first ones in having no motor equipment. They will be trailers, and it is expected that a good deal of the annoying vibration of the first cars will thus be overcome. The cars will be 54 feet long and will be provided with ten upper and ten lower berths. It is believed that this system may compete with through steam railroad service, for the reason that at night one does not care how fast he travels provided he can sleep comfortably and find himself at his destination when he wakes up in the morning.

The following subjects will be taken up at the International Congress of Telephone and Telegraph Engineers, which is to meet at Paris this year: (1) Manual versus automatic systems of telephone working. (2) (a) Simplification of telephone circuits; (b) selection of frequency and secondary potential (for purposes of theoretical investigation) with a view to facilitating the approach of the telephone current to the sine wave-form; (c) the circumstances conditioning the adaptability of telephone apparatus to the lines, induction coils, microphone resistance, etc. (3) Precautions to be taken for the avoidance of mutual disturbance in the case of power circuits running in close proximity to telegraph and telephone lines. (4) Telephony between places at great distances from each other. Construction of cables for long-distance use, relays, combination of aerial lines with cables. (5) Wooden poles—new process for impregnation and preservation—and procedure described from actual practice as to staying and strutting. (6) Party lines and selective calling upon telegraph and telephone lines. (7) Telegraph systems for heavy traffic. Multiple type-printing telegraphs and the Mercadier system.

SCIENCE.

Mr. H. H. Clayton, late of the Blue Hill Observatory, has gone to Buenos Ayres to organize kite and balloon observations under the direction of the Argentine Meteorological Service.

Knut Angström, professor of physics at the University of Upsala, died March 4th. He was distinguished as an investigator of solar radiation, and devised the instrument adopted by international agreement as the standard for measuring this element, viz., the Angström electric compensation pyrheliometer.

The International Meteorological Committee, which assembles triennially, will hold its next sessions in Berlin during the last week of September, 1910. Dr. W. N. Shaw, director of the British Meteorological Office, is president of the committee, and Prof. Dr. G. Hellmann, director of the Royal Prussian Meteorological Institute, secretary.

The standard troy pound of the Philadelphia Mint was recently tested by the Bureau of Standards and found to be slightly over weight, because of the accumulation of oxide on the surface. The test was certified to by the bureau officials in a report to the Director of the Mint. It was shown that when the weighing took place the temperature of the air was 22 deg. C., the relative humidity was 60 per cent, the barometer was 754 millimeters, the mean density of standards was 8.42 at 22 deg. C. The weight variation of the troy pound was determined to be 0.007 of a grain. This variation is what is called by scientists "tolerance," and is negligible. In the coining of \$100,000 the government would lose just \$121.53 as a result of the slight overweight.

The Flora bust controversy will not die. Dr. George Pinkus, the well-known German chemist, analyzed the wax in the famous bust and found it to be a combination of lac, spermaceti, and beeswax. Alleging that spermaceti was unknown until 1700, he argues that the bust could not have been Da Vinci's. Furthermore, he proved that the composition is identical with that used by Lucas, the sculptor who is said to have made the bust. Dr. Bode still maintains that the bust is a genuine Da Vinci. He replies that Prof. Rathgen made several analyses and found that the wax of the bust was different from that used by Lucas. In Dr. Fode's opinion, Dr. Pinkus analyzed only part of the outer layer of the wax, which Lucas added. Moreover, Dr. Bode quotes Prof. Lippmann of Halle University as authority for the statement that the peculiar wax in the bust was abundantly employed in Mediterranean countries at the beginning of the sixteenth century, despite the belief in some quarters that it was not known until 1700.

At the invitation of the Rochester Chamber of Commerce and the Civic Improvement Committee of that city the conference of 1910 will be held at Rochester, May 2nd to 4th. American cities are being aroused to the necessity for a city plan, and for the prevention of congestion of population. Many cities have plans; others are getting them; a few are following them out. Why it is imperative to adopt a city plan is becoming secondary in practical importance to how the city plan once adopted can best be carried out. The purpose of the conference this year is not primarily to continue the campaign of education, nor to increase the literature which makes up the already weighty argument for the necessity of planning American cities, but the conference is a gathering of experts called because of their intimate knowledge of a specific subject to make a concrete contribution to the science of city planning. Generalities will be most carefully avoided. The aim will be to discuss phases of each selected subject thoroughly, rather than to wander through the whole field.

Prof. Pierre Roveda, an architect of Buenos Ayres, has devised a special plan for the construction of whole districts of houses for the working classes. Instead of employing the usual square block as a unit, Prof. Roveda adopts a circle varying in diameter from 100 to 130 yards. This circle of ground is subdivided into 99 radial lots converging to a center. The circle is concentrically divided to form an interior avenue four yards broad, to permit of communication with the center of the circle. Each avenue leads to external sidewalks and to longitudinal and transverse streets. In the center of the circle is a plot of 40 yards in diameter, where children may be left to themselves without their parents' care, in charge of a specially designated person. In this garden a playroom, a school, a hospital, a fire station, and an administration room are to be found. Naturally this circular plot of ground will leave four corners free. In each of these corners Prof. Roveda intends to erect four chalets, such as grocery shops, dairies, haberdashers, and the like, which are to be conducted on a co-operative plan. In each of the 99 radial plots a workingman's house is to be built on the English plan. It is argued that the circular arrangement will give continuous sunshine at all hours of the day and plenty of light and air.

A NEW TYPE OF TORPEDO BOAT

A DOUBLE-HULLED BOAT WITH ITS ENGINES ENTIRELY BELOW THE WATERLINE

A new type of war vessel, provided for by Congress in the Naval Appropriation Act of last year, will be officially tested by the United States government at Boston within a few days. It is known as the subsurface torpedo boat, and is designed to be immune from the small-gun fire now relied upon as a protection against ordinary torpedo boats. It consists of a submarine hull, which contains all the machinery and torpedo armament, suspended from an unsinkable surface hull divided into compartments packed with cellulose. Last year's law authorizes the purchase of this boat, when the official trial shows that it fills requirements, and the construction under contract of two others of the same type. The boat has had a preliminary trial. Tams, Lemoine & Crane, the consulting architects, report that it easily made 18 knots an hour, thus exceeding the required speed by 2 knots.

Six tons is the weight of the vessel, and its length is 46 feet. The price which the government has agreed to pay is \$22,500. The small subsurface boats can either be used for coast defense or they can be carried on board of the larger vessels in an armored fleet. In time of action they can be launched and directed, by day or night, against the enemy's fleet, particularly for operations against ships lying under the protection of land fortifications or mine fields, where expensive battleships should not be risked, as they were at Manila, Santiago, and Port Arthur.

In the submarine hull of the new-style boat is an eight-cylinder gasoline engine of 150 horse-power. The explosive charge carried for use on hostile vessels is 1,000 pounds of guncotton. An armored conning tower on the surface hull, communicating with the submarine hull, enables the navigator to direct and control the boat's movements. Only two men are required on board.

It is estimated that a fleet of fifty of these subsurface torpedo boats will cost about as much as two or three destroyers or submarines. As their "cruising radius" is 200 miles, their principal function will probably be for the defense of ports and unguarded coast line.

The subsurface boat is to be operated in one of two ways. Either it may be steered within short torpedo range and aimed at its objective, the crew leaving it in lifeboats or buoys, or it may be fitted with a submerged bow torpedo tube to discharge the ordinary 18-inch torpedo.

For the firing of the high explosive use is made of an electrical firing circuit, which is actuated by a bow firing pin, but which is kept open and safe by a switch in the conning tower until the boat is deserted. It is also proposed to continue the firing circuit around the inner skin of the upper hull below the water line, so as to explode the charge if the boat should be rammed, and thus deter hostile boats from ramming. Also it is proposed to use on the engine sparking circuit a time switch, which will automatically break the sparking circuit and stop the engine and boat if it misses its objective.

The total government appropriation for boats of this

type is \$445,000. When the first is approved, the Navy Department is authorized to contract for two others, one more of the same size and one larger and faster—a \$400,000 "subsurface seagoing destroyer."

A year or two ago the Assistant Secretary of the Navy recommended the building of a number of small motor torpedo boats of approximately the same size as this, to be laid up on shore in peace time, for occasional practice runs by the naval reserve and for use by them in case of hostilities. The boats proposed were to be of 17½ knots speed, which is somewhat less



THE SUBSURFACE TORPEDO BOAT ON ITS TRIAL TRIP.

than has been achieved by the present subsurface boat on its preliminary trials.

The English motor torpedo boats built by Yarrow, with Napier engines, make about 18 knots. They are of about the same size as the vessel we are describing, and are used for the same purposes. It would appear, therefore, that no speed has been lost by carrying the engines and torpedo below instead of within the hull of the boat. It is suggested that in view of the comparatively small expense several flotillas of these boats could be distributed along our coasts and laid up with the engines greased, in which condition the expenses of maintenance would be very small.

There can be no doubt that all the navies of the world are just now directing special attention to subsurface warfare, and the trials of this boat, which offers some decidedly valuable features in the great protection afforded both to the motive power and the high explosive, will be watched with no little interest.

The general design of this very interesting craft is due to Clarence L. Burger, C.E., of New York, and the plans, calculations, etc., were made by the Naval Architects Tams, Lemoine & Crane.

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The Oldest Attic Letter.

A little leaden tablet, tarnished, ugly, and otherwise trivial in appearance, was sent a few years ago from Athens to the Imperial Museum of Berlin. On one side of it is some writing which only recently was deciphered with precise correctness by Adolph Wilhelm, an Austrian savant, who lives in Athens. The tablet is the original of a private letter that was written about the time of the orator Demosthenes.

The writer of the letter lived in a rural neighborhood and wished to send a commercial order to a town.

The form of the address was: "To be taken to the pottery market and to be handed to Nausias, or to Thrasykles, or to the son" (perhaps the son of the writer was meant). The weekly market, to which the Attic countrymen had gone to offer their produce and wares for sale, may be imagined as in progress. There the boy who was bearer of the letter was to find the stand or booth of one of the three persons to whom it was addressed and deliver it to him. The text of the letter says: "Mnesiergoes greets you cordially, he greets your family with the same esteem and wishes

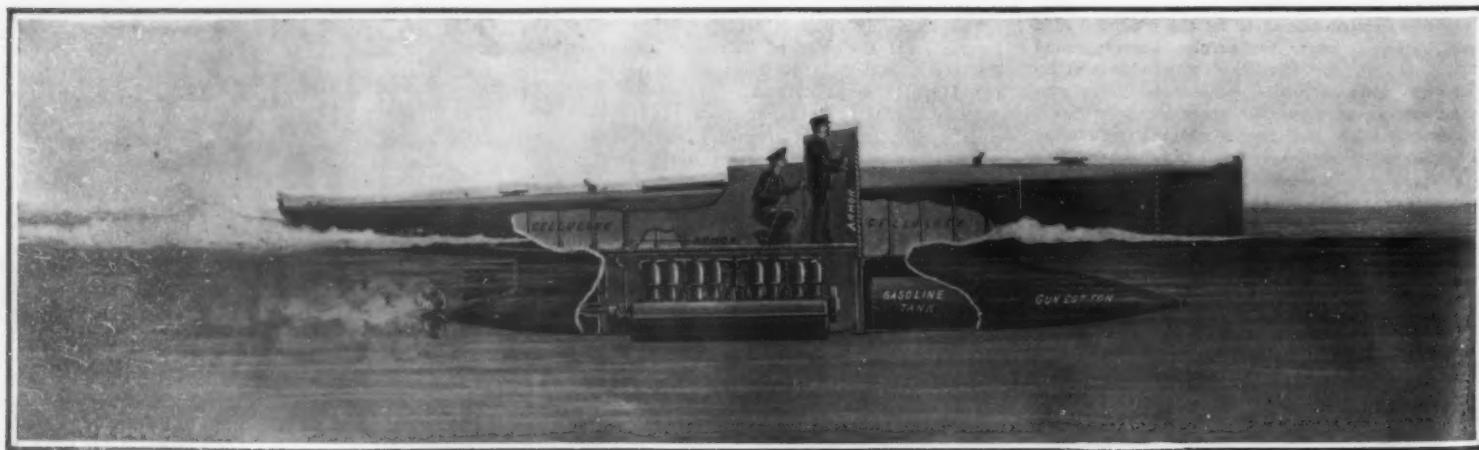
them good health, and he says also that his own health is good. Please be so kind as to send me a mantle, either of sheepskin or of goatskin, and let it be as cheap as possible, for it does not need to be trimmed with fur. Send with it a pair of heavy soles also. As soon as I have an opportunity I will pay you."

So much for the letter, to the motive of which the reader can point with as much precision as the author. Apparently it was written in winter, poor Mnesiergoes having been surprised out in the open country by one of those icy snowstorms which sometimes even at this day cover the temples of the Acropolis with a mantle of snow. Therefore he desired to receive as quickly as possible the heavy and warm garment of the poorer countrymen, a goatskin,

which could be bought for four and a half drachmas, and the strong soles which were worn under the ordinary sandals on the rural plains and hillsides. A good pair of the latter could be bought for four drachmas, as a well-preserved bill of that date shows.

A noteworthy feature of this artless letter is the formula with which it begins, the very formula that may be found used in very numerous letters that were preserved by the Greek literature of later times. Even at the present day every letter written by a rural Greek begins with the same cordial inquiry about the health of the person to whom the letter is written and with brief information about the health of the writer.

Although it is possible to resolve into gas almost any kind of solid fuel in a gas producer, it is well known that certain fuels—particularly those high in ash and of a caking character—give a good deal of trouble. One of the most serious of these troubles, states a contemporary, is that the fuel welds itself into a large mass which partially chokes the fire in some places and causes passages or holes to be burnt at others. Hence poking of the fire is necessary, and the poorer the fuel the more the poking. In order to reduce this poking to a minimum some producer makers fit shaking or revolving grates. The latest design of this character is due to Mr. Chapman, an American, and it is a considerable extension of the principle. The lower portion of the producer is divided into two or three rings, which are free of each other and rotate at different speeds, the joints between them being made by water seals. The object is to shake the fuel continuously, so that caking or clogging and holes are equally impossible.



This little craft, 45 feet 9 inches long, carries its war head and engines in a suspended cigar-shaped hull which lies entirely below the waterline and therefore out of reach of the enemy's projectiles. The upper hull, being filled with cellulose, is designed to be unsinkable. In attacking, the boat would be driven at the enemy at its full speed of 18 knots, and when it was within striking distance the crew of two men would jump overboard, locking the rudder and leaving the boat to explode its charge of 1,000 pounds of guncotton by bodily ramming the ship.

NEW TYPE OF DESTROYER FOR THE NAVY.

TRACKLESS ELECTRIC TROLLEY-DRAWN SLEIGH IN NORWAY

BY FRANK C. PERKINS

The accompanying illustration shows a novel sleigh trailer in Drammen, in service during the past winter in Norway as drawn by the trackless electric trolley.

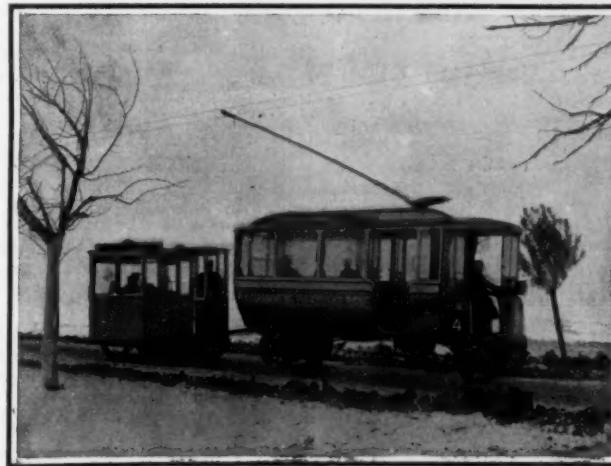
The novel construction of the trackless trolley car of the A. S. Drammens Elektriske Bane is shown in the illustration as placed in operation by the Gesellschaft fuer Gleislose Bahnen Schiemann of Wurzen in Saxony, Germany. There are two overhead conductors provided along the Drammen River over the roadway for a distance of 3.5 kilometers (2.49 miles). The city of Drammen has about 35,000 inhabitants, who are served by this electric trackless trolley line. There are four motor cars in service, which have run 125,000 car kilometers (77,671 car miles) during the past year.

A direct current of 5,000 volts is used on the overhead trolley line, this current being supplied from a sub-station equipped with motor generators and step-down transformers. The current is generated at a hydro-electric power plant 40 kilometers (24.85 miles) away and transmitted to the sub-station at an alternating current of high voltage. The alternating current is transformed to a direct current by a converter of 60 kilowatts capacity. The cars weigh about 3,000 kilogrammes (6,614 pounds) each and are provided with rubber-tired wheels. An electric motor of from 15 to 22 horse-power capacity is utilized, which drives the trackless trolley car at a normal speed of about 20 kilometers (12.43 miles) per hour. The cars are lighted with five tantalum incandescent lamps of 32 candle-power each. It will be noted that the trolley pole is similar in those of American construction, but provided with two conductors and contacts of the sliding type for both trolley wires instead of the usual single trolley wheel used on electric railways.

Every winter the demand for fresh eggs becomes more insistent and more difficult to supply. Poultry breeders in different parts of the world have en-

deavored to supply the deficiency by artificial selection. By this process an Australian breed of fowls which averages 270 eggs per hen per year has already been produced. A series of very interesting experiments on the same subject has been carried on during the past ten years at Macdonald College, in Montreal, which is reputed to be the most perfectly equipped school of agriculture in America. Starting with breeds noted for their endurance of cold, especially

a foot thick, upon which wheat or millet, the only food given, was strewn at regular hours. The hens were kept busy from morning until night in hunting for their food in the straw. This active exercise prevented the accumulation of fat and stimulated the production of eggs, for every poultry farmer knows that fat hens are poor layers. Hence, as hens, like all other birds, naturally store up fat at the approach of winter, the problem became limited to preventing this accumulation of fat, and at the same time assuring to the hens an abundance of food. The problem appears to be in a fair way of solution, for the hens of Macdonald College produce an average of 200 eggs per year, from one-fifth to one-fourth of which are laid during the rigors of the Canadian winter.



A PASSENGER SLEIGH DRAWN BY A TRACKLESS ELECTRIC TROLLEY.

Plymouth Rocks and White Wyandottes, the experimenters began the process of selection by allowing the fowls to leave the poultry yard and scratch in the snow in the coldest weather. The progeny of the fowls which availed themselves of this privilege was subjected to similar treatment, which was continued for several generations. The poultry houses were not heated, even when the temperature fell to zero Fahrenheit, although the fowls were slightly protected from the cold by screens placed around their perches. The poultry yards were covered with a layer of straw

concrete-lined trench in the firing floor. This trench is sloped to one side of the building, where it connects with a flume extending on a grade of about 5 per cent to the edge of the river bank. When the grates are cleaned the ashes are pulled into the trench and a hose stream turned into the latter to start them. They are thus picked up by and carried out in the river through the flume. No difficulty is experienced from clogging in the trench or flume, and the current in the river prevents an accumulation at the edge of the bank.

THE EARLIEST STORY OF THE DELUGE

PROF. HILPRECHT'S REMARKABLE DISCOVERY

One of the most remarkable discoveries which has ever been made in Assyriology, a discovery which rewards greatly to the credit of the University of Pennsylvania and to the credit of Prof. H. C. Hilprecht, is the finding of an account of the Babylonian Deluge which antedates any Deluge narrative extant. The significance of the discovery is enhanced by the fact that in the most important details it agrees remarkably with the Biblical version of the Deluge, much more so in fact than any other cuneiform version thus far unearthed.

The work of Prof. Hilprecht is of fundamental importance for the correct determination of the age of Israel's earliest traditions; for the Nippur tablet, upon which the story is written, was inscribed before Abraham had left his home in Ur of the Chaldees.

Upon Prof. Hilprecht's recommendation that his discoveries be made accessible to the scientific world as quickly as possible, a paper by him has recently been published by the University of Pennsylvania, which bears the title, "The Babylonian Expedition of the University of Pennsylvania. Series D: Researches and Treaties. Vol. V. Fasciculus." From this paper the following abstract is made:

Toward the end of October, 1909, while unpacking and examining two boxes of cuneiform tablets from the fourth expedition of the University of Pennsylvania to Nippur, Prof. Hilprecht's attention was attracted by some fragments which presented certain peculiarities, and which, unlike the others in the boxes, were not written in Sumerian, the ancient sacred language of Babylonia, but in the Semitic dialect of the country. This fragment was so completely covered with crystals of niter and other sediments

that, when taken out from its paper wrapper, at first only a few cuneiform signs could be recognized. Three characters in particular, standing together in the upper section of the fragment, were fortunately free from incrustations. The words were *a-bu-bi*, "de-

cued Lot from the hands of Amraphel of Shinar and Chedorlaomer of Elam (Genesis 14). Furthermore, in its preserved portion it showed a much greater resemblance to the Biblical Deluge story than any other fragment yet published.

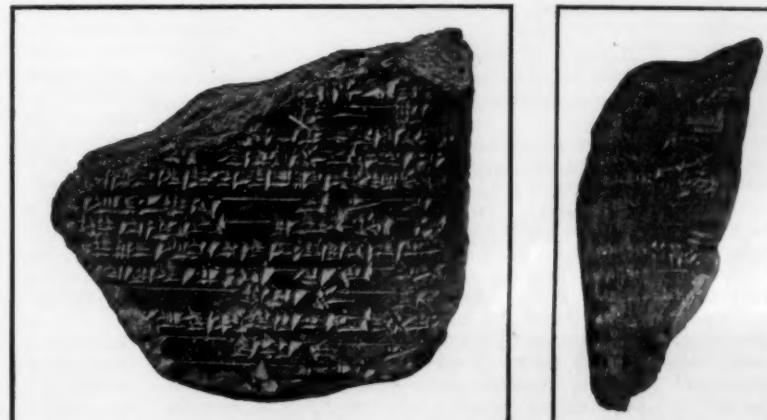
The cuneiform text of the fragment contains a portion of the divine command to the Babylonian Noah, Ut-na-pish-tim, to construct a ship and to save life from the all-destroying flood. Apart from the tradition of a great flood handed down by the Babylonian priest Berossus (living between 330 and 250 B. C.), but preserved only in extracts by other ancient writers, there are fragments of three distinct Deluge versions in cuneiform writing.

The first of these is the version from the library of King Ashurbanapal (668-626 B. C.) which was restored from a number of fragments found in the ruins of Nineveh, and which is an Assyrian copy of a Babylonian original.

The second is a somewhat different version of the Babylonian Deluge story and is found on Fragment "D(ally) T(elegraph) 42," which likewise came from the royal library of Nineveh and was inscribed about the same time (c. 650 B. C.).

The third fragment is that acquired and published by Prof. Schell of Paris, and now in the possession of Mr. J. Pierpont Morgan. It is dated "in the year when King Ammi-zaduga built Dur-Ammi-zaduga at the mouth of the Euphrates," i. e., the eleventh year of his government, in other words, according to Prof. Hilprecht's reduced chronology, about 1868 B. C.

An examination of the cuneiform text of the Nippur fragment and a comparison of this new version of

FRONT AND EDGE VIEWS OF THE NIPPUR VERSION OF THE DELUGE.
DATE, APPROXIMATELY, 2100 B. C.

luge." Prof. Hilprecht's attention was naturally aroused. For three continuous weeks he personally spent from one to two hours every day endeavoring to uncover one cuneiform character after another by removing the incrustations and other deposits of hardened dirt without damaging the writing below, until he had completely deciphered every sign. The fragment proved to be a somewhat incomplete but unmistakable account of the Deluge about 1500 years older than similar fragments obtained from the library of Ashurbanapal (668-626 B. C.) and was inscribed more than 600 years before the time generally assigned to Moses, and even before the Patriarch Abraham res-

the Babylonian Deluge story with the parallel passages of the two Nineveh versions and the Biblical story have brought out the significant fact that, with all due allowance for a general resemblance between the three cuneiform versions, the Nippur version of the divine announcement of a great flood and the command to build the ark differs fundamentally from the two Nineveh versions, and agrees most remarkably with the Biblical story. This agreement affects that part of the Pentateuch (Gen. 6: 13-20; 8: 11) which Old Testament critics style P. (=Priestly Code) and generally regard as having been "compiled in Babylonia about 500 B. C." The importance of this new text to theological students cannot be overrated. Written as it was about 2100 B. C., this new version came into being at a time when the sanctuary of Enlil at Nippur was supreme among the Babylonian temples and was the center of literature. When Hammurabi, the Amraphel of Genesis 14, conquered Rim-Sin of Larsa, the various petty Babylonian states constituting geographically the ancient kingdom of Shumer and Akkad were united politically by the conqueror. Babylon on the Euphrates became the metropolis of the united empire. After Ammi-ditana, the third successor of Hammurabi, Nippur disappears rapidly from history. It reappears with the rise of the Cassite dynasty in Babylonia, about 1400 B. C., and its sanctuary again rises to hold a conspicuous place for several centuries. The revival is but the last flicker of a fast dying flame.

In Prof. Hilprecht's opinion the Temple Library at Nippur was a most insignificant institution after 1000 B. C., and it flourished most gloriously before 2000 B. C. The priests of the Cassite and Neo-Babylonian periods produced few, if any, original literary compositions of value at Nippur, more delighting in the statement at the end of their tablets that the text was "a faithful copy of an old Nippur original." The literary activity of the priests was transferred to other centers, like Babylon and Sippar. It is therefore evident that the Nippur fragments, antedating the two Nineveh versions by 1500 years, represent the oldest version of the Babylonian Deluge story in a Semitic translation, made doubtless from a much older Sumerian original which has not yet been discovered, and that the later cuneiform versions are different editions of the same story with considerable changes, abbreviations, and additions. The Deluge story of the so-called "Priestly Code" must form part of the oldest traditions of Israel, as Old Testament scholars have pointed out.

Even the Amarna period (about 1400 B. C.) with its unsettled conditions in Palestine, when the influence of Babylonia upon the shaping of the government and the religious conceptions of Palestine was almost *nil*, cannot explain its presence in the Old Testament. The only period when the oldest version of the Deluge story could possibly have entered Canaan was the time when Abraham, whom Prof. Hilprecht regards as an historical personage, left his home on the Euphrates and journeyed westward; in other words, the period of the first dynasties of Isin and Babylon, of which Hammurabi or Amraphel is the central figure, the time when the Amorites knocked at the gates of Babylonia, invaded the country, and soon overthrew the old dominion.

Although the interpretation of the Nippur tablet is by no means easy, it can be stated with safety that in accordance with the exalted position held by Enlil in the old Babylonian pantheon as "father of the gods," it was in all probability Enlil himself who warned Ut-na-pishtim to take refuge in an ark. Here then, as in the Biblical version, the Lord of the Universe himself both causes the Deluge and saves Noah from destruction by warning him and ordering the construction of an ark.

We present herewith in parallel columns the translation of the actual preserved portions of the ancient Nippur version and the corresponding passages of the Old Testament according to the Hebrew text. The similarity is at once striking, so much so in fact that the blanks in the Nippur version can easily be supplied by the more complete account:

Nippur Version.
Line 2: "I will loosen."

Biblical Version
(Gen. 6:13-20; 7:11.)
7-11: "All the fountains of the great deep were broken up, and the windows of heaven were opened."

3: "It shall sweep (or 'take') away all men together";
4: "life (?) before the deluge cometh forth";
5: "(over) 'as many as there are, I will bring overthrow, destruction, annihilation.'"
6: "build a great ship and its structure";
8: "it shall be a house-boat carrying what has been saved of like";
9: "with a strong roof over it";
10: "(the boat) which thou shalt make";
11: "Instead of a number";
12: "and family";
13: "but with thee I will establish my covenant";
17: "and behold, I do bring the deluge upon the earth, to destroy all flesh, wherein is the breath of life, from under heaven: everything that is on earth shall perish";
14: "make thee an ark...";
15: "...and thus thou shalt make it... and thirty cubits its height";
16: "A roof shalt thou make to the ark, in its (entire) length thou shalt cover it; and the door of the ark shalt thou set in the side thereof: (with) lower, second and third stories shalt thou make it";
19: "And from every living thing, from all flesh, two from everything shalt thou bring into the ark, to keep them alive with thee; they shall be male and female";
20: "(two) from the birds instead of a number thereof; (two) from the beasts instead of a number thereof; (two) from everything creeping on the ground instead of a number thereof";
18, b: "and thou shalt come into the ark, thou and thy sons, and thy wife, and thy sons' wives with thee."

The Current Supplement.

The current SUPPLEMENT, No. 1787, contains a most remarkable number of interesting articles. Karlernst Knatz writes on the modern use of police dogs, and R. W. Raymond on quantitative and qualitative thinking. Prof. R. S. Woodworth deals interestingly with the "typical" man, a creature who does not exist, but yet who is very necessary in the endeavor to classify

is described by C. Van Langendonck. C. L. de Murali writes on modern development in heavy electric locomotives. Among the very subtle notions which often embarrass the teacher of mechanics, none more frequently leads to erroneous interpretations than the two aspects in which acceleration may be considered, but there is also none which when once mastered is more fertile of results in thorough instruction. For that reason teachers will no doubt read with interest Mr. C. E. Guillaume's excellent article entitled "Paradoxes of Acceleration." One reason why the turbine has not completely supplanted the reciprocating engine in ship propulsion is to be found in the fact that it is not reversible, and in the second fact that screw propellers are most efficient at a rate of speed considerably lower than the rate of speed which is best for efficiency and economy of turbine operation. To overcome these drawbacks Dr. H. Foettinger has invented a system for which he claims not only a high degree of efficiency, but reversible action without mechanical complications. The feature of this invention which is most thoroughly described in the current SUPPLEMENT is a relatively light and simple hydraulic transmission device, the so-called turbo-transformer. G. H. Bryan contributes some new ideas on the subject of aeroplane stability.

NEW AUTOMOBILE RECORDS AT ORMOND BEACH.

Once again the famous sands of Ormond Beach have been used for making new records with automobiles. During the three days' meet held last week Barney Oldfield once more beat the world's record for speed with his new 200-horse-power Benz racer, a picture of which is reproduced herewith. This machine broke four world's records last fall upon the Brooklands

track in England, and so it is not to be wondered at that upon the smooth sands of Ormond it traveled two miles in the fastest time ever made by an automobile. The distance was covered in 55 87/100 seconds, which is nearly three seconds better than the record of 58 4/5 made by Demogeot in 1906 with a Darracq car. The rate of speed traveled by Oldfield is 128.89 miles an hour. Oldfield also made new records for the kilometer and the mile; he covered the 3,280 feet of the first-mentioned distance in 17 4/100 seconds. The previous record was 17 76/100. His record for the mile, which was made a week previously, was 27 33/100 seconds, a speed of 131.72 miles an hour. Walter Christie's front-drive racer covered this distance in 30 39/100 seconds, or at the rate of 118.46 miles an hour.

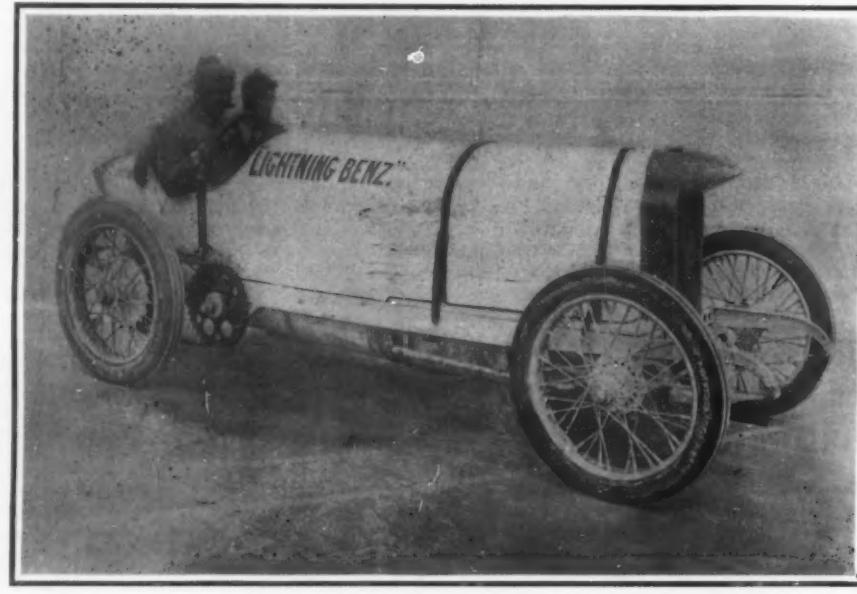
In the stock car races, Oldfield made a new record of 40 35/100 seconds for one mile

in a Knox machine. This make of car also won the 10-mile free-for-all in 8 41/100 minutes; a Chalmers 40-horse-power car took second place; the 10-mile handicap was also won by a Chalmers car, which beat the Pope-Hartford, the time being 12 minutes and 13 seconds. On the last day of the meet, in the one-mile speed trials, Oldfield covered the distance in 27 88/100 seconds. The 10-mile stock chassis race for cars having a piston displacement of 161 to 230 inches was won by Hart in a Buick in 12 minutes and 58 seconds, or at the rate of 46.27 miles per hour. A Hudson machine came in second. In the 10-mile handicap a Darracq car driven by Kirscher won in 7:21; Oldfield on a Knox was second, and Bond on a Stearns third. A second 10-mile handicap race was won by Altman on a Hudson in 12:45; Oldfield with a Knox was again second, and Kirscher third.

In the one-mile speed trials the Darracq covered the distance in 37.24, and Walter Christie made it in 33.15.

While the races this year were not very numerous, Oldfield created a great deal of enthusiasm by his record-breaking driving, and it is probable that next year still other attempts will be made to reduce the time for short distances. The machine Oldfield used is in every way similar to a regular stock car except that it has a much larger engine of 185 x 200 millimeters (7.3 x 7.9 inches) bore and stroke, capable of developing considerably more than its rated horse-power.

A large portion of the old French plant at Panama was found to be serviceable, and is doing good work on the canal. Since 1906 the useless junk has been sold as scrap, and up to January, 1910, over ten thousand tons have been shipped and sold.



THE 200-HORSE-POWER BENZ RACER IN WHICH OLDFIELD MADE 128.89 MILES AN HOUR. A NEW WORLD'S RECORD.

The Nature of the Interior of the Earth.

Especially during the past few years the structure and temperature of the interior of the earth have been an object of lively and insistent discussion; and not a lesser result of it is the plan to bore a hole to the kernel of the earth, by means of which may be investigated all the strata of the globe, which as they succeed one another toward its center indicate an increasing temperature in conformity to a law. Flammarion particularly has quickened this question very recently, and with it has busied the fancy both of expert and of layman. As lending further vivid importance to the discussion, the gist of certain chapters of Dr. W. L. Meyer's book, "Bewohnte Welten" (Inhabited Worlds), recently published, may be cited. It affords a most interesting estimate of the temperature of the crust of the earth and of the interior volume of our native planet. This research discloses that the varying temperature of the atmosphere exercises an influence on the temperature of the crust of the earth only to quite inconsiderable depths. Already at a distance of fifteen to twenty meters below the surface a uniform temperature of 9 deg. Celsius approximately has been ascertained, which prevails around the whole earth. With increasing depth the degree of heat is enlarged. This increase is called the geothermal degree of depth. In many holes that have been bored it varies with much frequency. Generally 1 deg. of increase of temperature of rock is indicated as often as 33.3 meters of greater depth are added. This result is due to the mode of observation that informs us of the characteristics of two kilometers, or the thirty-two-hundredth part, of the distance toward the center of the earth. Here at this depth a temperature of 50 deg. was ascertained. If this manner of calculation be continued for greater degrees of depth the immediate result is that already at 60 kilometers, approximately, the constituents of the crust of the earth are in fiery solution, and at 300 kilometers must be in the form of gas. The latest investigations conducted by Meyer remind us of the research of Tamman and others and of the results of experiments made to measure the speed of the progress of waves of seismic disturbance. The collective result leads to the conclusion that the real firm crust of the earth cannot be specifically thicker than 100 kilometers. Among the phenomena sustaining this conclusion is the so-called magma which is occasionally expelled in a volcanic eruption; when nearer to the center of the earth it has the form of gas, but under such stupendous pressure that at the distance aforementioned the substance seems to have the appearance of wax. So it is assumed that the temperature of the center of the earth lies between 20,000 and 100,000 deg.

At this juncture Dr. Meyer seeks to satisfy the curiosity of the inquirer with his statement of the equation of heat that occurs between the earth and the sun; the store of heat, "great beyond human computation, that streams forth over the geothermal degrees of depth from the interior of the earth into endless space is so far counterbalanced by the heat imparted to the earth by the rays of the sun that no decrease of the mean temperature of the surface of the earth can be ascertained. It must be noted therefore, that as on the temperature of the earth depend the most important processes of life, these are assured for an indefinite time at least.

An Eruption of Etna.

On March 24th the Sicilian volcano Etna began to erupt. The lava united in a vast stream 24 feet high and 1,200 feet wide, and at the time of going to press was threatening the destruction of Belpasso and Borello.

The lava devastated large tracts of cultivated lands, such as vineyards and orchards, and has wrought havoc in the woods. The village of Nidolo, near Nicolosi, has been covered completely, and many huts and farmhouses have been destroyed.

BUILDING THE HUGE CONCRETE LOCKS AT GATUN, PANAMA.

SPECIAL APPLIANCES BY WHICH THIS HUGE ARTIFICIAL MONOLITH, 400 FEET WIDE, 4,000 FEET LONG, AND 90 TO 100 FEET DEEP, IS CONSTRUCTED.

The work at Panama, and particularly at the great flight of double locks at Gatun, has now reached a stage at which the camera is able to catch some adequate impression of the titanic proportions of the work and record it for the interest of the outside world. We have all understood that the scale upon which work was being done at Panama was impressive, but it remains for the accompanying pictures to teach us just how stupendous is the mass of masonry which is slowly taking shape near the Atlantic end of the canal.

The locks at Gatun will pass vessels up or down between sea level and the level of the lake which will be formed by the great Gatun dam immediately adjoining the locks. The total height of 85 feet will be covered in three flights of approximately 28 feet each. In order to provide ample accommodation for future increase in traffic, and also as a contingency against total disablement of the locks, they are being built in duplicate, as shown in the plan herewith presented. Each lock will be 110 feet wide, and will have a usable length of 1,000 feet. To provide against the carrying away of gates and the consequent rush of water out of the lake, the former will be built in

them of 18 to a maximum of 22 feet, the size varying according to the number of side culverts that are served. Now it can readily be understood that the cost of a work of this kind, involving the handling of 4,000,000 cubic yards of material, depends very largely upon the amount of labor involved. For in works of this character the cost of labor is the principal item, and hence much thought has been given to the design of the appliances for handling the concrete and the huge "forms" (temporary inclosing walls) within which the concrete is deposited. At the Gatun locks the sand and stone are deposited from cars in a stock pile running parallel with the lock site. On either bank above the huge excavation in which the locks are being built are a series of lofty steel towers (see front page and Figs. 2 and 7), between which are strung heavy, steel cables, by which the buckets containing the materials are transported. The concrete is picked up by these cables, run over the excavation and lowered at the desired point.

The first part of the concrete work consisted in the laying of the huge slab of concrete, 392 feet wide and nearly 4,000 feet long, with a maximum thickness of 20 feet, which forms the floor of the locks. During the construction of this floor, care was taken to provide circular transverse conduits with vertical openings through the floor, which led alternately to opposite side walls, there to connect with the main longitudinal, emptying and filling conduits. The next task was to erect the side walls; and it is this interesting work which is shown so clearly in the accompanying illustration.

The walls are built in sections, each of which is about 40 feet wide, with a space of about 30 feet between them. The wall is then completed by filling in the intervening vertical gaps.

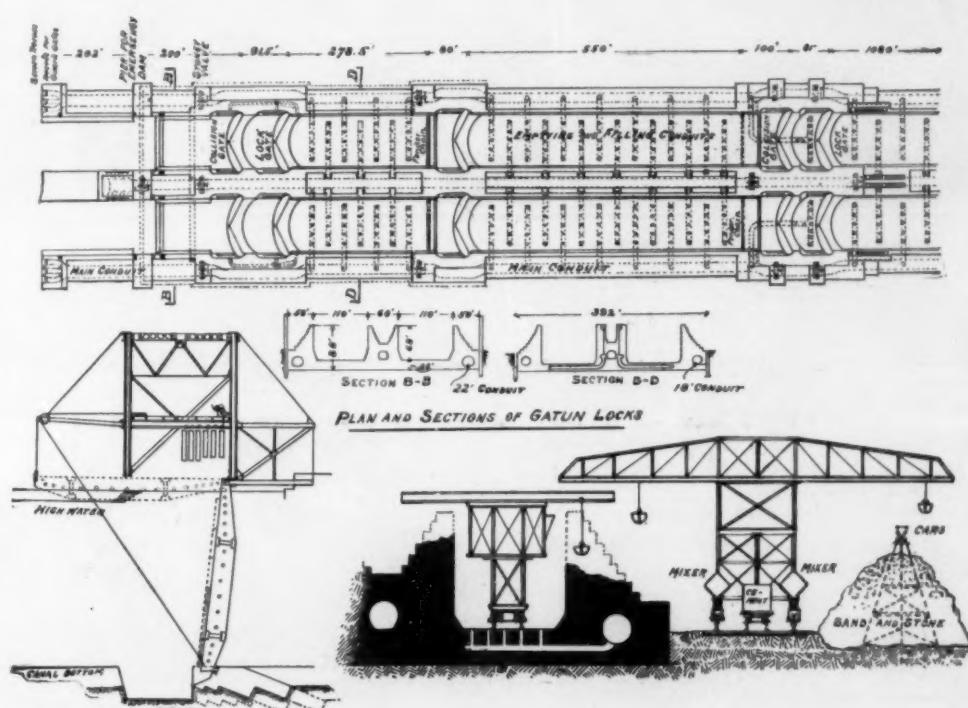
It is well understood that one of the most expensive elements in concrete construction is the building and manipulation of the forms in which the concrete sets. In smaller structures these are composed of timber; but because of the huge amount that would be required and the big depreciation in the value of the timber after use, this material was altogether out of the question. The plan adopted is shown very clearly in our illustrations. The forms are built entirely of steel (Figs. 2, 4 and 5). Those for the inner vertical face of the walls consist of a series of massive steel towers of a triangular cross-section,

duplicate, with a considerable space of water between them; so that if a ship, overrunning, should strike the first gate, the second will remain intact. Also, at the entrance to the upper lock, there will be a huge swing bridge which, in the event of the gates being carried away, can be swung across the lock entrance, and a series of horizontal, vertically sliding steel gates lowered down from the bridge, thus effectually shutting off the flow of water. Heavy fender chains will also protect the gates by receiving the first shock of a collision and thus, partially if not altogether, absorbing the momentum.

But the present story is concerned with the methods which have been adopted for building this huge monolithic, or unjointed, mass of artificial masonry, into the construction of which will enter about four million cubic yards of concrete. In general, the locks may be described as consisting of a floor, 400 feet by 3,800 feet in area, and of 20 feet maximum thickness, of two side walls, 50 feet in thickness at their lowest part, and of a central dividing wall, 60 feet thick. (See diagrams.) The clear height of these walls from the floor of the dock to the coping is 68 to 96 feet. The inner faces forming the sides of the lock are vertical. The outer faces are built on an incline and are stepped, the horizontal thickness increasing with the depth of water in order to resist the lateral pressures. For emptying and filling the locks a series of transverse culverts, formed in the floor, lead to large longitudinal culverts in the base of the walls (Figs. 1 and 6), the latter ranging in diameter from a mini-

tion of 18 to a maximum of 22 feet, the size varying according to the number of side culverts that are served. Now it can readily be understood that the cost of a work of this kind, involving the handling of 4,000,000 cubic yards of material, depends very largely upon the amount of labor involved. For in works of this character the cost of labor is the principal item, and hence much thought has been given to the design of the appliances for handling the concrete and the huge "forms" (temporary inclosing walls) within which the concrete is deposited. At the Gatun locks the sand and stone are deposited from cars in a stock pile running parallel with the lock site. On either bank above the huge excavation in which the locks are being built are a series of lofty steel towers (see front page and Figs. 2 and 7), between which are strung heavy, steel cables, by which the buckets containing the materials are transported. The concrete is picked up by these cables, run over the excavation and lowered at the desired point.

The first part of the concrete work consisted in the laying of the huge slab of concrete, 392 feet wide and nearly 4,000 feet long, with a maximum thickness of 20 feet, which forms the floor of the locks. During the construction of this floor, care was taken to provide circular transverse conduits with vertical openings through the floor, which led alternately to opposite side walls, there to connect with the main longitudinal, emptying and filling conduits. The next task was to erect the side walls; and it is this interesting work which is shown so clearly in the accompanying illustration.



Cross-section of emergency dam in the closed position, with wicket girders down and sliding gates partly in the lowered position.

How the 4,000,000 cubic yards of concrete are being mixed and built into place at the Canal locks.

BUILDING THE HUGE CONCRETE LOCKS AT GATUN, PANAMA.

tion, to the vertical face of which is riveted a wall of steel plating, stiffened by horizontal channel irons. The towers are carried upon four 4-wheel trucks, two under the front and two under the rear face, which run upon two pairs of rails laid on the floor of the lock and parallel with its longitudinal axis. The rear face of the walls, which is stepped, closed by a series of separate rectangular forms measuring about 6 feet on the vertical and 4 feet on the horizontal face. The ends of each wall section are closed by means of steel plates supported against vertical movable framework. Into the pocket as thus formed the concrete is dumped from the skips of the overhead cable, and tamped into place by the laborers, until the full 6 feet of height corresponding to the height of the rear stepping is completed. The walls are thus carried up three at a time until they have reached their full height. This work is very clearly shown in the front page engraving, where a skip is shown as having just delivered its load and the laborers are spreading and tamping the concrete.

To assist in making a firm joint between the monolithic sections, vertical and horizontal key-ways, or pockets (Fig. 5) are formed in the abutting faces, which pockets are, of course, filled in with concrete as the intervening gaps between the walls are built up. This system of keying, coupled with the natural adhesion of the concrete, will prevent any tendency to cracking or separation of the walls at these points under hydraulic or earth pressure, or under the racking strains of an earthquake shock.

A most interesting piece of steel form work is that

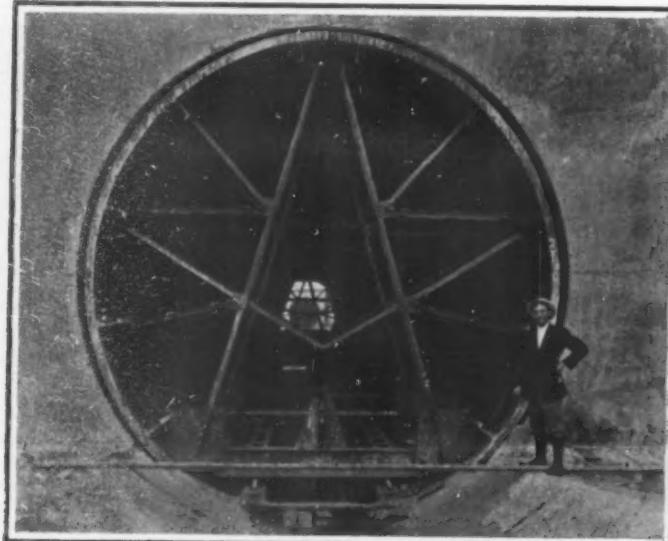
for forming the 18 to 22-foot conduits in the side walls. It consists of a flexible steel pipe (Fig. 1), heavily braced to resist deformation, which has a longitudinal hinge at the top, and at the bottom is provided with heavy left and right screws, by which the form is kept to its full dimension during the laying and setting of the concrete. To remove the forms, the screws are turned and the bottom edges of the form are drawn together, thus reducing the diameter and allowing the form to be drawn clear of the conduit.

A most interesting picture is Fig. 3, showing the work at the entrance to the locks from Gatun dam. To the right is seen the rear stepping of the easterly

wall of the easterly lock. The circular timber work shows the position of the upper end of the first lock. Just beyond this are two sections of the steel forms for the main central conduit by which water will be led from the lake to the upper lock. Just beyond the wall which extends across the picture to the right-hand bank will be located the emergency dam above referred to; and beyond that will extend the three piers which will form the lock entrance from the lake. The embankment which will be seen running out as an extension of the natural bank to the right of the picture is the rock fill forming the southerly toe of the great Gatun dam, which extends to the right across the valley to a junction with the

distant hills. The lake of water seen to the right of the rock embankment is formed by the hydraulic dredges which are being used in making the Gatun dam. Half a mile to the north, also extending across the valley from the northerly end of the locks, is a similar rock fill; and huge dredges are now engaged in pumping silt and water from the Chagres, and from the various contiguous channels, into the big basin half a mile wide and over a mile long thus formed. The water drains off through the rock fill, leaving the fine silt in a firmly compacted, impermeable mass, which is so dense that it will be impossible for the waters of the lake ever to seep through.

If the reader have sufficient imagination he can, by



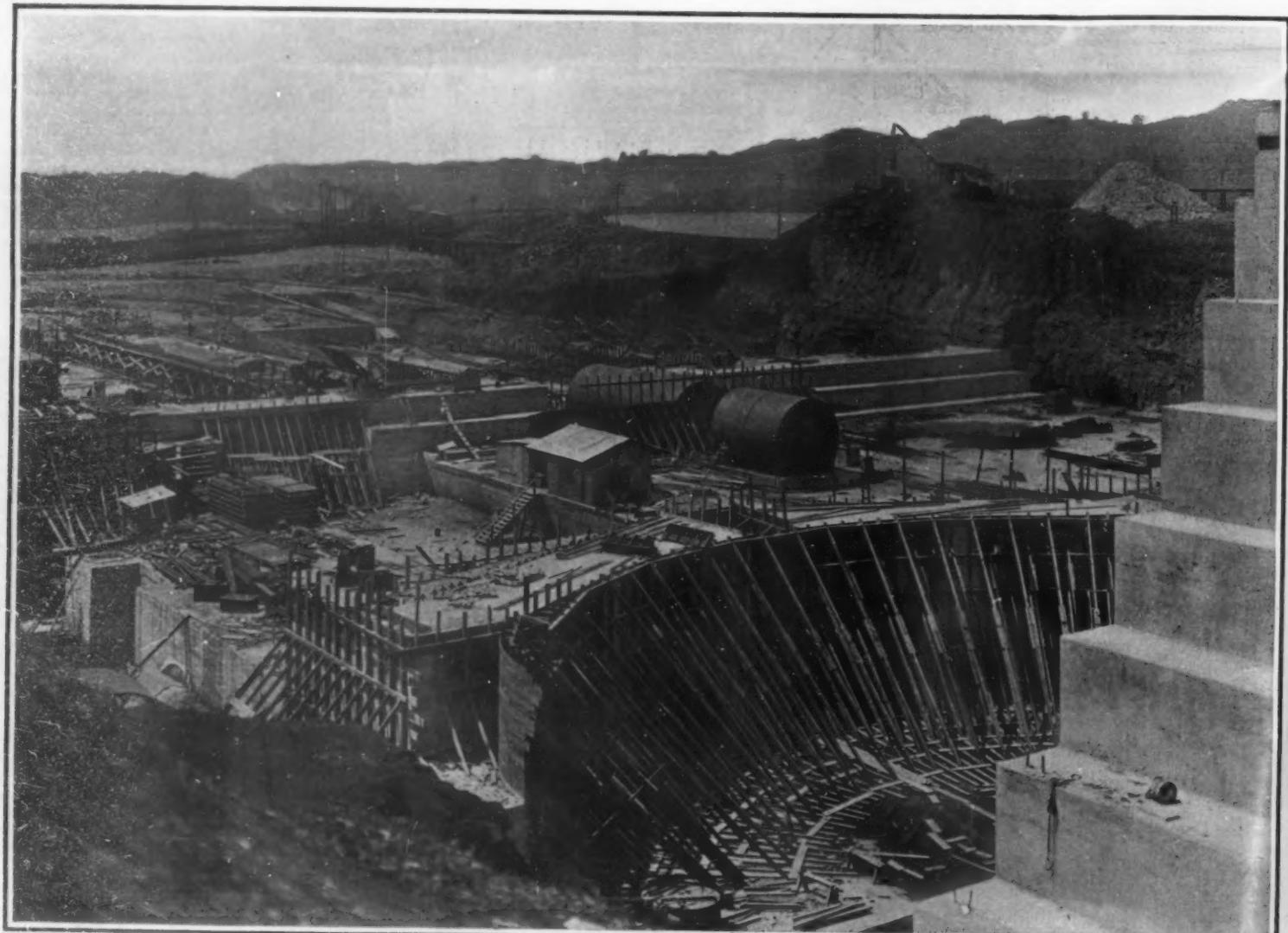
The conduits are formed in the body of the side and center walls. The forms consist of collapsible steel cylinders, hinged at the top, split at the bottom, and kept in place by big right and left screws. The latter are loosened, when the concrete has set, allowing the two halves of the cylinder to swing inwardly and be withdrawn.

Fig. 1.—An 18-foot conduit for emptying and filling the locks.



Looking into the middle lock excavation from the east bank. To the left, section of side wall with forms yet in place. In center of excavation, the middle wall is being built in sections. To the right is a side wall section showing the movable form in place and a portion of the track upon which it is transported.

Fig. 2.—General view of middle lock.



In foreground is the timber form for upper end of upper lock. In center of stepped wall are the steel forms for conduit for filling the locks. Beyond the wall will be the emergency dam and the entrance piers, which will extend several feet into Lake Gatun. To the right is the rock fill which forms the southern toe of the Gatun dam. Back of it are the water and silt, which have been pumped up from the Chagres to form the main body of the dam.

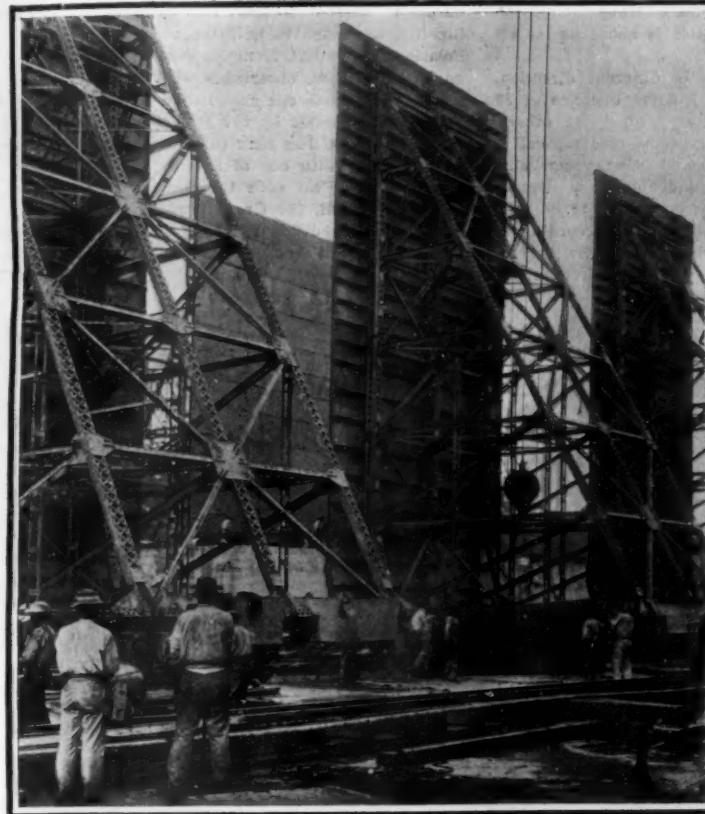
Fig. 3.—General view of south end of Gatun locks.

looking at this picture, fairly depict the scene as it will appear when the canal is completed, supposing, of course, the side wall were broken away to give him an unobstructed view. To the right the bank will be shut off by the walls of the lock structure, and to the left he will see the three concrete piers extending far out into a vast lake of water which will cover all the space now occupied by tracks, telegraph lines, and embankments, and will extend in an unbroken surface until it reaches the hills in the far distance.

Efficiency of Steam Turbine Nozzles.

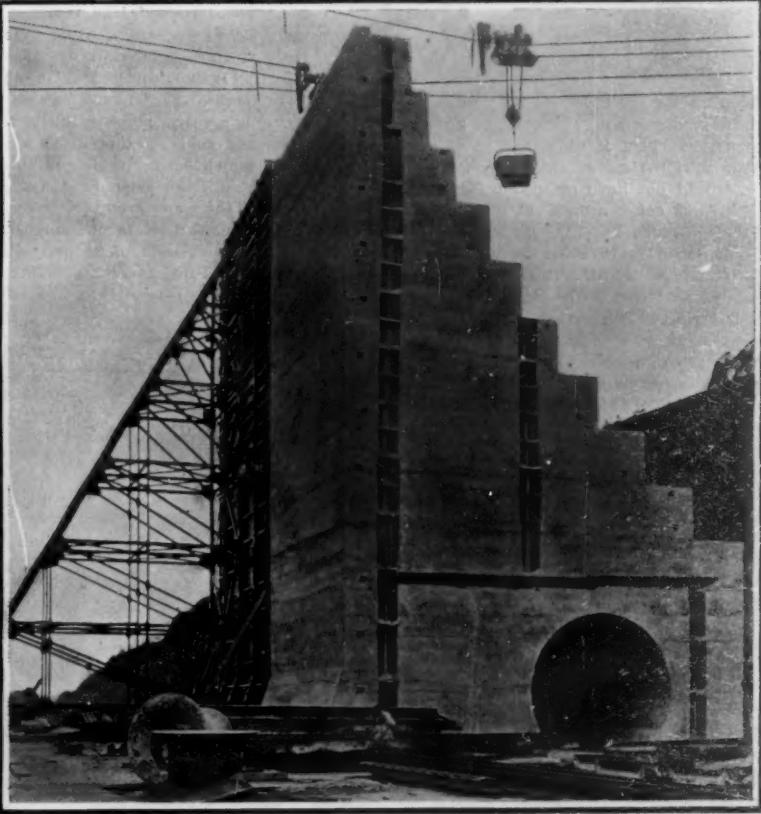
Some experiments upon steam turbine nozzles, expanding steam from ordinary boiler pressures to condenser pressures, are described in a paper presented to the American Society of Mechanical Engineers by Prof. Sibley and T. R. Kemble. The main results are worth noting, and confirm the claims made for the efficiency of nozzles by turbine makers. Efficiencies of from 90 to 95 per cent were regularly obtained. The actual discharge from the nozzles,

stated as a percentage of the theoretical discharge, was of the same order as the efficiencies. Most interesting, however, was the apparent lack of influence exerted by the form of the nozzle, even when this might have been expected to be considerable, as, for instance, when the section changed from circular at the neck to square at the discharge, or when a conical needle protruded into the nozzle from the inlet end. Smoothness of surface was, however, an important factor.



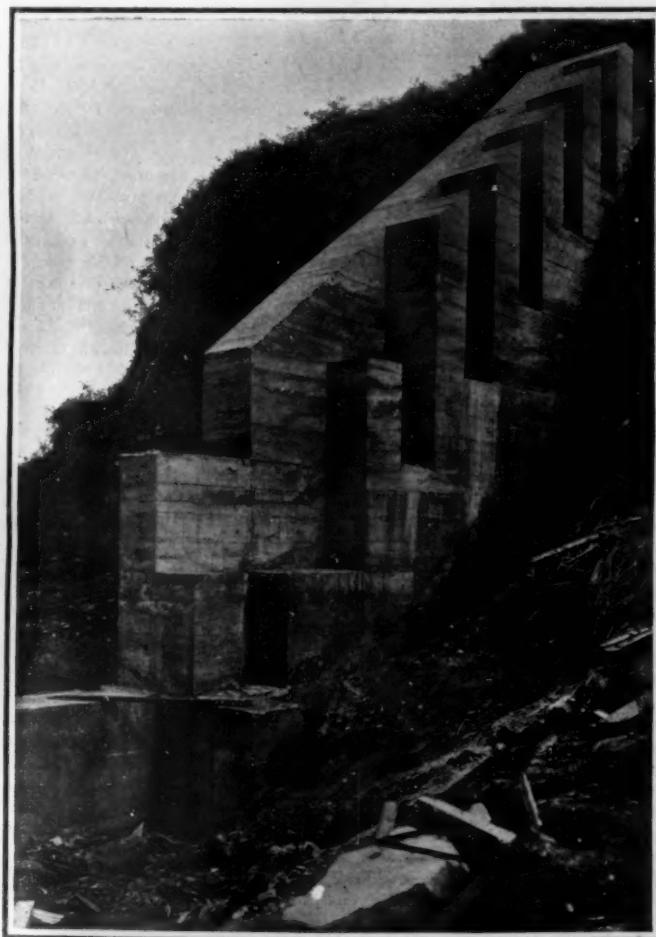
These movable forms, consisting of vertical plate steel walls carried on trussed steel towers, are each mounted upon four four-wheel trucks, and run upon two lines of double track, extending the full length of locks.

Fig. 4.—Steel forms in place for building center wall.



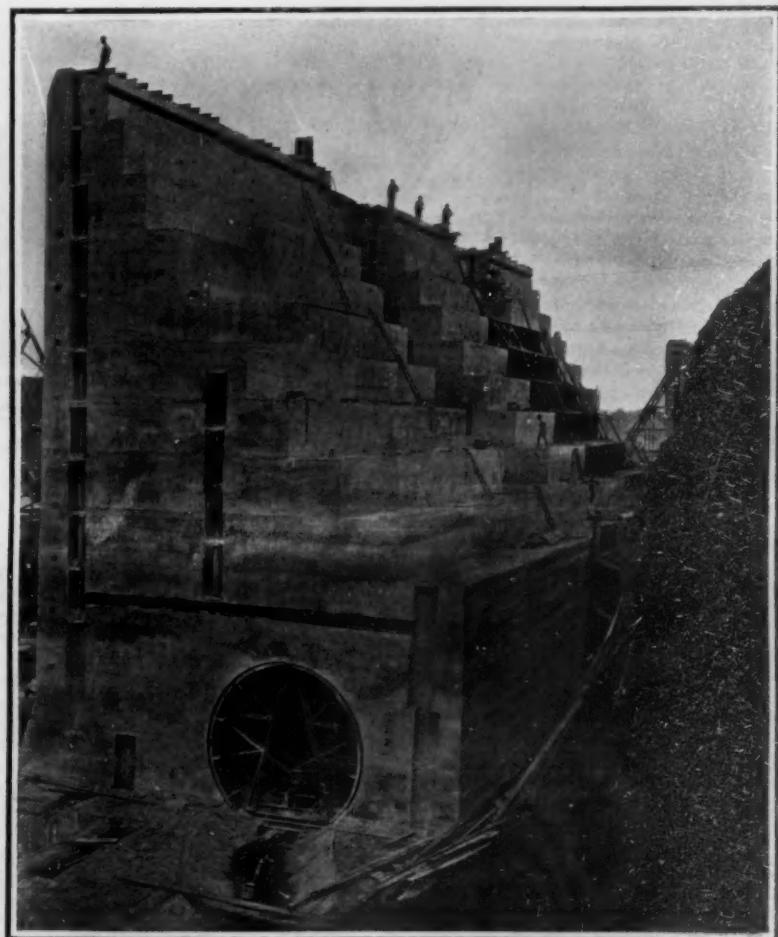
This is a completed section of the middle lock side wall. It is 50 feet wide by 78 feet high. In the base is one of the main filling and emptying conduits. The vertical recesses are to assist in keying the section together.

Fig. 5.—A completed section of side wall.



This wall, carried down everywhere to solid rock, will serve to prevent seepage of water through the earthen dam.

Fig. 6.—Portion of concrete core wall, Miraflores dam.



The gaps will be filled with concrete, keyed and cemented firmly in place, thus providing a continuous monolithic wall. The steel angle plate forms are already set up across the further gap.

Fig. 7.—Sections of easterly side wall, upper lock.

THE HEAVENS IN APRIL

BY HENRY NORRIS RUSSELL, PH.D.

THE great comet which was so conspicuous in January is again observable, in the morning sky, just before daylight, but only with telescopic aid. Its orbit is now well determined, and it appears that it was nearest the sun, at a distance of 10,000,000 miles, about the time of its greatest brightness, and that its rapid fading was due to its steady recession from both earth and sun. Its orbit is probably very nearly parabolic. That it could not be of short period was clear at the time of discovery, for so bright an object could not have escaped being seen often before, if it had come around at moderate intervals like Halley's comet.

The latter is invisible behind the sun during the early part of April, but is well placed for morning observation toward the end of the month. At this time it appears almost stationary in the heavens, south of the eastern edge of the great square of Pegasus, and is high enough to be observed before 4 A. M. Its distance from the earth decreases from 158,000,000 miles on the 1st to 77,000,000 on the 30th, and its apparent size and brightness will steadily increase. By the end of the month it will doubtless be conspicuous to the naked eye.

While waiting for this, we will find abundant occupation among the stars. Before we trace out the constellations into which the imagination has grouped them, let us study a real family of stars, whose relationship has but recently been discovered.

It has already been told in these columns how Prof. Boss has identified about forty members of a group of stars in Taurus which are keeping together in their movement through space like a flock of wild geese in the air.

It has also been known for some time that five of the bright stars of the Great Bear form a similar group, and recently, through the studies of two German astronomers, Lüdendorff of Potsdam and Herzsprung of Göttingen, it has been found that several other conspicuous stars, in different parts of the sky, also belong to it. All these stars are really moving in the same direction, and at the same rate, and hence they all appear to be moving away from the same point in the heavens, though in quite different directions, for some pass our system on one side, and some on another. They ought on this hypothesis still to be approaching us, and the spectroscope shows that this is actually the case; the observed velocities of approach agreeing closely with those predicted by theory.

The stars of this system are shown on our map. First comes the group in Ursa Major—the stars β , γ , δ , ϵ , and ζ , all in the Great Dipper—with Alcor, the small companion of Mizar (ζ), and also two other stars not shown on the map; one of them about a degree from ϵ , a little above the line joining it to ζ and the other the northernmost of two fifth-magnitude stars not quite half way from β toward ϵ , which latter star is shown on the map north of θ .

All these eight stars are relatively about as close together as they look to us, and are at about the same distance from our solar system—65 to 75 light-years. This can be calculated with accuracy when once we know how fast they are really moving and how fast they seem to move. The point from which, owing to perspective, the motions of all these stars appear to be directed is on the borders of Ursa Major, and is pointed out by a line from θ through α Ursa Majoris,

carried as far again. The other stars of the group are identified by the fact that their apparent motions are also directed away from this point, though they are widely scattered over the sky. Two of them are nearly in line with the stars of the Dipper, though far removed on each side— β Aurigae and α Coronae. The former is the remotest of the group, about 150 light-years away, while the latter is about as far off as those previously described.

Farther southward, in quite a different direction, is the star δ Leonis, whose calculated distance of 39 light-years puts it much nearer than these others, and suggests that direct observations of its parallax would be desirable. Finally, and most remarkable of all, the splendid Sirius is undoubtedly a member of the same group. It owes its brightness to its relative nearness to us—only $8\frac{1}{2}$ light-years according to the demands of theory, which in this case is confirmed in a most satisfactory way by direct observation.

we may fix our eyes first on the North Star. The Little Bear, to which this belongs, while not one of the most conspicuous groups, is easily recognizable, being a tolerably good "Dipper," though less lifelike (if the phrase may be pardoned) than its larger neighbor. The figure of the Bear, as shown in our initial, can hardly be made out except that the line of stars ending in Polaris makes quite an unnaturally long tail. Polaris itself, apart from its position, is noteworthy as a double star, observable with a small telescope, while the spectroscope shows that the brighter one of the two is attended by two invisible companions, one with a period of less than three days, the other, much more remote, with one of several years.

Around the Bear coils the Dragon, and higher up, almost overhead, the Great Bear pursues her course. South of this we find the Lion, and below, all along the southern sky, the ungainly length of the Sea Serpent, Hydra. Above this come the small constellations of the Crow and the Cup, and then the Virgin,

all whose stars are far surpassed by Jupiter, their companion. In the east we see the red Arcturus, and lower down the semi-circle of the Crown, and Hercules, just rising. Passing around to the north, we find Cepheus and Cassiopeia, below the Pole, and then Perseus and Auriga in the northwest. Taurus is low in the west, and Gemini above him, with the planet Mars between the two. Orion and Canis Major are the southwestern sky, with Canis Minor above.

THE PLANETS.

Mercury is theoretically a morning star until the 5th, and an evening star after that date; but he will not be observable until the latter part of the month, when he sets an hour and a half after the sun and should be easily seen shortly after dark. At this time he is in Taurus, and on the 29th he passes close to the Pleiades, which he much surpasses in brightness.

Venus is a morning star, rising about 4 A. M. on the 1st and 3:15 A. M. on the 30th. She is extremely brilliant, and cannot possibly be mistaken.

Mars is evening star in Gemini, slowly moving eastward among the stars and still losing in brightness as he recedes from us. He is very far north all through the month, and consequently remains in sight until after 11 P. M.

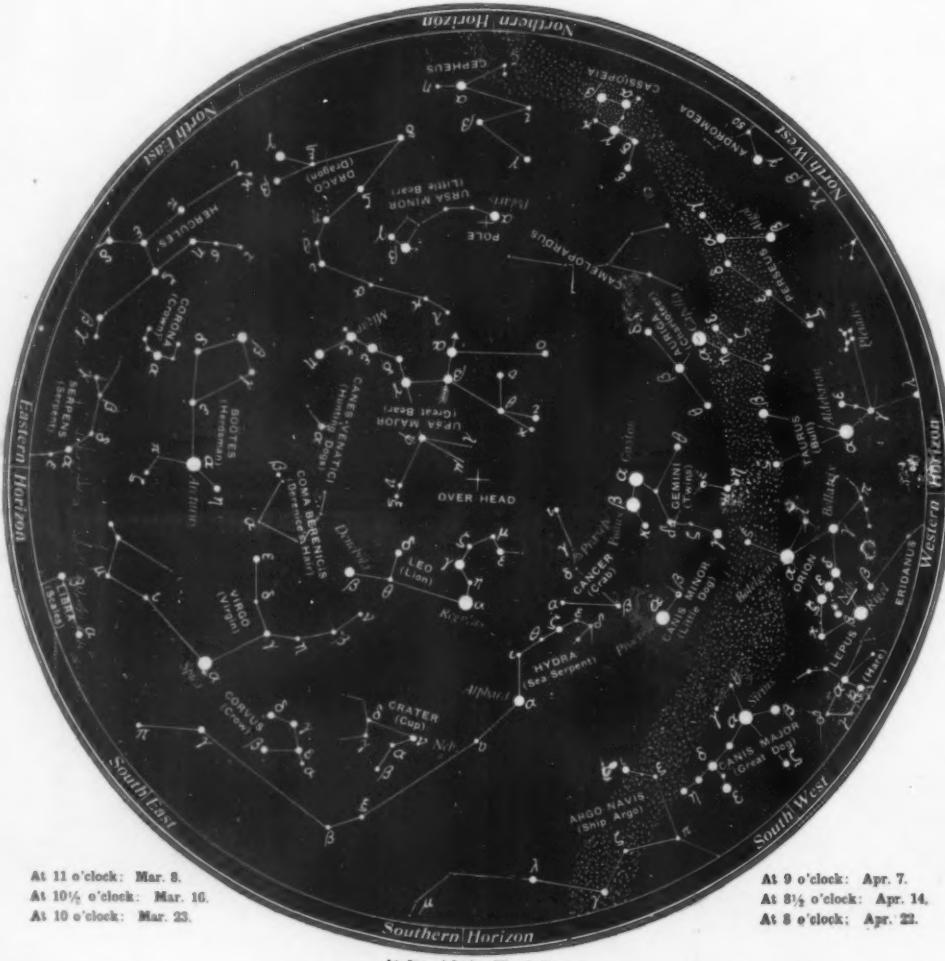
Jupiter is just past opposition, and dominates the evening sky. Telescopically, the transits and eclipses of his satellites are among the most fascinating spectacles in the heavens, especially when the round black shadows of the satellites can be seen on the planet's disk, as happens on the 3d, 9th, 10th, 18th, and 25th during the evening hours in our part of the world.

Saturn is in conjunction with the sun on the 16th, and is unobservable throughout the month.

Uranus is in quadrature west of the sun on the 15th, and is observable in the morning. Neptune, which is in a similar position on the opposite side of the sun on the 7th, can be seen, with a suitable telescope, in the evening.

The moon is in her last quarter at 8 P. M. on the 2d, new at 4 P. M. on the 9th, in her first quarter at 9 A. M. on the 16th, and full at 8 A. M. on the 24th. She is nearest us on the 10th, and farthest away on the 24th. She is in conjunction with Uranus on the 3d, Venus on the 6th, Mercury and Saturn on the 9th—the three bodies being apparently close together, but also so near the sun that they cannot be seen—with Mars on the 13th, Neptune on the 15th, and Jupiter pretty closely on the night of the 21st.

Princeton University Observatory.



NIGHT SKY: MARCH AND APRIL

When the actual brightness of the other stars of the system is computed, it is seen that Sirius is actually one of the fainter members of the system. Its total light is about thirty times that of the sun, while that of the principal stars of the Dipper and of α Coronae averages fully twice as much, and that of β Aurigae is about ten times as great. Delta Leonis, on the other hand, is only about ten times as bright as the sun, and the fainter stars near the Dipper, belonging to the system, while still exceeding the sun in luminosity, are only two or three times as bright.

This system therefore consists of unusually bright stars. It is remarkable also for the great extent in space. Between the outer stars of the group there must be hundreds of stars, of which our sun is one, which have no connection with it. It is as if a dozen men were all walking through a confused crowd, all in the same direction and at the same speed. Though many of the crowd intervene, the mere fact of their progress toward the same point serves to distinguish them, and is a mark of their common origin.

It may be added in conclusion that a very large proportion of these stars, at least six out of the ten shown on the map, are either visually or spectroscopically double. Turning now to the constellations,

NOVEL CHANGEABLE PHOTOGRAPHS

BY F. HONORE

Prof. Lippmann recently described before the Academy of Sciences at Paris some novel changeable photographs made according to a method devised by M. Estanave, secretary of the Faculty of Sciences of Marseilles.

M. Estanave produced a dia-positive on glass of a sleeping woman. By inclining the picture a few millimeters and rocking it slightly, the eyes apparently open like the eyes of a porcelain doll, with the exception, however, that the entire face livens up in a most extraordinary manner. Incline the picture back and the eyes slowly close again. The photographs when reproduced for publication in a paper such as the SCIENTIFIC AMERICAN unfortunately cannot be used to obtain the effect because of the necessity of employing a special half-tone screen.

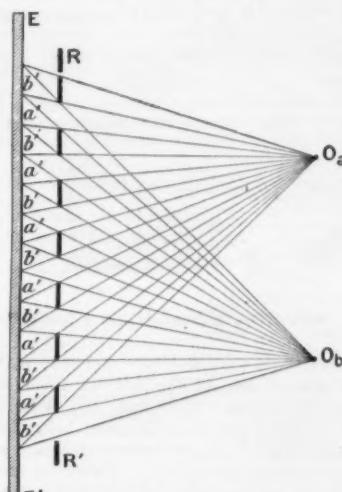
In order to explain how M. Estanave obtains his picture, let us consider two different photographs—the one *D* representing a sleeping woman, the other *E* the same woman awake. Each photographic positive is ruled horizontally from top to bottom, so that both photographs appear finely banded. If we remove from the positive *D* even alternate pairs of bands, and from the positive *E* odd alternate pairs of bands, and if we place upon the positive *D* the bands taken from *E*, and upon *E* the bands taken from *D*, we will obtain two new pictures, which we may designate *D'* and *E'*. These new pictures *D'* and *E'* are composites of *D* and *E*. If the bands are narrow enough, 30 per centimeter, for example, their

strips of *E'* without disturbing their order. We obtain still another positive *D'*, formed by the combination of the two preceding positives. When looked

through a screen similar to that by means of which the picture was made, and the visual angle be varied either by shifting the eye or shifting the screen, the portrait will apparently open and close its eyes.

Theoretically several different pictures can thus be superimposed. In actual practice M. Estanave has combined three which are clearly visible. However, there is a limit to the number of pictures that can thus be combined, for the positives become more and more incomplete as the filiform bands composing them are more and more elongated. In the case of two aspects, the elements of an image are adjacent, the one to the other; with three aspects, the consecutive elements of an image are separated by two elements belonging respectively to each of the two other images, and so on.

In order to simplify the adjustment of the screen relatively to the composite image, and in fact to avoid adjustment entirely, M. Estanave employs an improved auto-stereoscopic plate which he has invented. This plate is ruled with a screen on the side which is not emulsified, the rulings being such that alternate opaque and transparent bands are produced. The new invention of M. Estanave's is so conceived that the plate serves a double purpose. The plate is mounted with the ruled surface in front; or it can be so placed that the ruled surface is either horizontal or vertical. When the ruled surface is placed horizontally, changeable photographs are obtained. With the ruling vertically placed images can



MODIFIED FORM OF THE DISCOVERY.

at directly this new positive *D'* is rather confusing; but when looked at through a glass plate ruled alternately with horizontal opaque and transparent bands of a width equal to those constituting the positive itself, quite a different effect is obtained. If we hold this glass screen in such a manner that the opaque bands cover the bands of the positive *E'* we will see only the bands of the positive *D*, and we will obtain the portrait of a sleeping woman. On the other hand, if the screen is slightly shifted so that the bands of the positive *E'* are covered we will have a portrait of a woman wide awake. Since the different effects are obtained simply by shifting the screen, the single photographic view seen through it can be caused to change its appearance very rapidly simply by changing the speed of the screen movements.

In actual practice the ruling of the positives and the transposition of the bands, as well as the use of a suitable screen, is attended with considerable difficulty. For that reason, M. Estanave has devised a simpler method which is illustrated in the accompanying diagram.

Let *a* and *b* be two different objects, the luminous rays from which fall upon a sensitive plate or a ground glass *EE'*. In the path of these rays at a suitable distance, the horizontal ruled screen *RR'* is placed. In the diagram the spaces separating the lines of the screen are considerably exaggerated and the screen itself is shown in vertical section. Such is the position of the screen that the sensitive plate will receive a series of images of *a'* alternating with images of *b'*.

In making the positive photograph according to this method, the subject is first placed at *Oa* and then at *Ob*. At *Oa* the subject must appear asleep, and at *Ob* wide awake. A composite picture will be obtained on the sensitive plate. If this picture be examined



THE SLEEPING WOMAN.

discontinuity will not be noticed. The composite pictures will apparently be complete and comparable with the half-tone pictures to be found in the SCIENTIFIC AMERICAN or in any other modern illustrated periodical.

Let us now combine the two composites *D'* and *E'*. In other words, let us transpose strips of *D'* and

obtained directly visible to the eye with a stereoscopic effect. With two stereoscopic lenses mounted so as to obtain filiform images formed by the superposition of the two images of the object taken under the same aspect, the vertical lines of the screen select for each eye the particular image of the stereoscopic couple which are intended for it.

Mother-of-Pearl Imitations.

At a very early period repeated efforts were made to replace mother-of-pearl, so expensive at times, by some substance possessing the same valuable properties, but the results arrived at always fell far short of the expectations which were entertained, and these attempts were, therefore, gradually entirely abandoned. Recently attention has again been directed to the same problem, it being believed that the progress made in chemistry and applied science afforded grounds for hoping for more favorable results. And, in fact, some of the imitations of mother-of-pearl now made seem to show that these expectations will not be disappointed. It is true that hitherto but few detailed directions for making artificial mother-of-pearl have appeared in technical literature, for the simple reason that the methods which have led to successful results have for the most part been kept carefully secret, but a careful study of international patent literature shows that there are now various processes for making these imitations, some of them resting on a solid scientific basis. It is at once evident that imitations such as sheet gelatine steeped in fish-scale essence, or Cologne glue saturated with aluminium silver, will never gain a footing as genuine substitutes when, for instance, not even the well-known celluloid mother-of-pearl can gain recognition

as an equivalent. The purpose to which artificial mother-of-pearl is applied determines the degree of its efficiency as a substitute, and this degree of efficiency in its turn depends mainly on its external resemblance to the natural product. For combs, hat-pin heads, etc., celluloid mother-of-pearl may be used without hesitation as an imitation; for ornaments, on the other hand, such as fastening pins, buckles, etc., the preference will naturally be given to substances whose external resemblance to the genuine material is complete or nearly so. Special interest, therefore, attaches to a new method of preparing artificial mother-of-pearl, which we proceed to describe in detail.

The ascertained fact that collodion, mixed with carbon bisulphide and a few parts of pearl-silver fluid, yielded a substance more or less resembling mother-of-pearl, led to a method of working directly with cellulose solutions, and in this way the celluloid mother-of-pearl already mentioned was obtained, a material which has been used for a variety of purposes in the industrial arts. As, however, the inflammability of celluloid considerably restricted the employment of this new material, efforts were made to replace celluloid by another substance. This substance was cellulite. The process of preparing artificial mother-of-pearl from this base is as follows: 100 parts of cellulite dissolved in 80 to 90 parts of glacial acetic

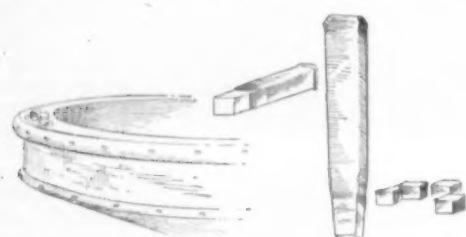
acid or chloroform are mixed with 20 parts of calcined magnesia and 4 to 8 parts of pearl essence, with continual stirring. In this way a more or less viscous mass is obtained, which is allowed to dry in the air. If a few drops of carbon bisulphide are added to the liquid solution, a beautiful iridescent luster is imparted. As cellulite dissolves comparatively slowly, it is advisable to prepare the solution a day or two beforehand. In case of need, the process of dissolving may be somewhat accelerated by slow heating in a water-bath. When dry, the artificial mother-of-pearl presents the appearance of polished mother-of-pearl plates, but in addition it is distinguished by great ductility and elasticity. The treatment of this artificial product is, therefore, much easier than that of genuine mother-of-pearl. It has also been attempted to substitute mother-of-pearl dust for magnesia, and very satisfactory results have been obtained in this way. It is also possible by means of this process to produce artificial pearls exactly like real ones. For this purpose the artificial product is prepared in rather thick plates, from which sticks are cut and pearls of any desired size and form turned on the lathe. These pearls are superior in point of resemblance to the natural product to the fish or wax pearls hitherto made from glass, and are not so brittle as the latter.—Deutsche Goldschmiede Zeitung.

NOTES ON OVERHAULING A BOAT

BY ALBERT F. BISHOP

Square Bunging for Boats.—I think square bungs are a big improvement over round bungs. They do not weaken the planking or chafing streaks and may more quickly be inserted.

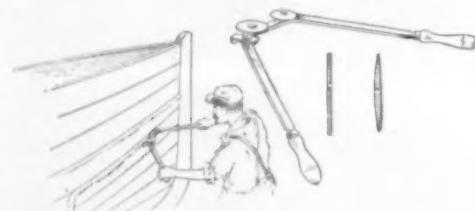
The chafing streak on a round stern that has been bunged with round bungs invariably breaks sooner or later where the round bungs have been inserted. Where the square bung is used the nail is driven and



SQUARE BUNGING.

set. The square punch, which is a trifle larger than the nail head, is then driven in making the aperture for the square bung. This punch should be hardened and ground on an emery wheel, making the corner just as keen and sharp as possible. Oblong rectangular bungs are preferable where the boat nail is used in planking, etc. The bungs are quite easily made $5/16$ of an inch square with a small buzz saw, tilting the saw table slightly to produce the taper on two sides of the bung.

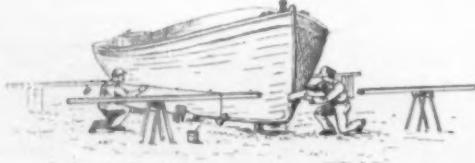
Wheel Calker.—The wheel calker illustrated here with will easily force cotton into solid wood where there is no seam or joint. The shape gives one considerable leverage. The cotton is first placed along the seam by attaching it with the point of a knife at short distances, just enough to keep it in line with



WHEEL CALKER.

the joint. It is now ready for the knife shaped wheel, which calks it very rapidly. Take a strip of iron $\frac{1}{8}$ by $\frac{1}{4}$ inch thick, $2\frac{1}{2}$ feet long, and bend it to a flaring U-shape. The bottom of the U should be 4 inches across and to it the wheels are riveted. The iron strip should be drawn down a little on the ends to receive the handles. The wheels are $1\frac{1}{4}$ inches in diameter. One of the wheels has a square edge $1/16$ of an inch thick. The other wheel is $3/16$ of an inch thick with the edge sharpened like a knife. There is a simple gauge placed on the framework near the square edged wheel which allows one to force the cotton to the desired depth to receive the putty.

Marking the Water Line on a Boat.—Level the boat athwartships, and decide where you would like your water line, which in the case of a launch or small motor boat should be from two to three inches out of water when the boat is afloat. Take two straight edges 12 or 14 feet long, placed level athwartships to the boat, one at the bow and one at the stern, at the height of the water line decided upon. Stretch a



MARKING THE WATER LINE ON A BOAT.

cord across the straight edges with the weight at each end to keep it taut and let it just touch the bilge of the boat so that you may dot your water line along the hull. The proper way to make a true line is with a thin batton 3 or 4 inches wide and 10 or 12 feet long, with the upper edge pressed against the boat to correspond with the dots. Be particular to keep the batton exactly plumb edgewise and you can correctly scratch in your water line.

Simple Method of Weighing a Boat.—Take a lever six or eight feet long, place a fulcrum on the ground

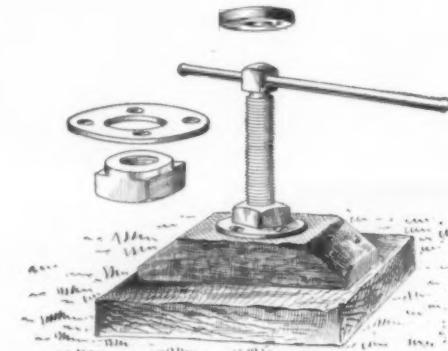
near the bow. Let the fulcrum (at 2 in the drawing) be just six inches from the end (1) of the lever that is under the bow of boat. A person that would weigh, say a hundred and fifty pounds, should work along on the lever, say to 3 or until the weight of his body would just lift the bow of the boat clear of the blocking. With a piece of chalk make a mark on the lever at this point. Divide the distance from the fulcrum to the chalk mark into 6-inch spaces and add 150 pounds for each space. For instance, eight space



WEIGHING A BOAT WITH A LEVER.

would mean 1,200 pounds, which would be a little less than half the weight of the boat, as the bow end is generally the lighter. Now raise the stern with the lever in the same manner. The boat being heavier at this end will call for more spaces. When this weight has been determined add the two weights and the result will not be far out for the entire boat. The blockings the boat rests on while the boat is lifted should be at the extreme end.

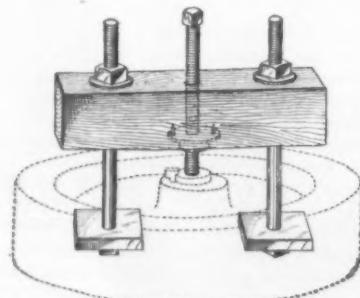
A Home-made Lifting Jack.—The jack here illustrated is made with a screw an inch in diameter and eight or more in length and a good heavy nut, the corners of which have been notched down with a file to receive a heavy washer. The part of the nut which comes through the washer should come through far



A HOME-MADE LIFTING JACK.

enough to allow for good heavy riveting on the washer. This makes the base for the nut to rest on and it is then placed on a wooden block, which is well secured with four wood screws. The base of the jack is a heavy block placed with the grain running at right angles to the upper block which holds the nut. The cap and lever require no description. The broad base prevents the jack from settling in the earth and from capsizing as well, which is a good feature around boat work.

A Home-made Wheel Puller.—A simple wheel puller can be made by taking a piece of maple about $3\frac{1}{2}$ inches square and about sixteen in length and fitting it with the bolts about as shown in the accompanying sketch. The nut for the center screw has the washer



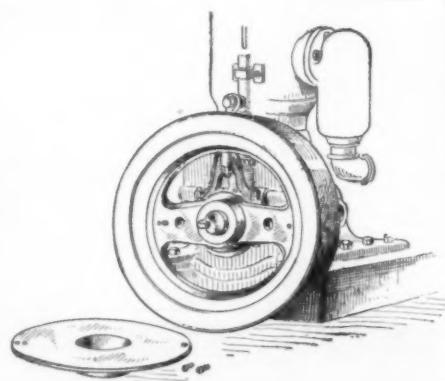
HOME-MADE WHEEL PULLER.

attached to it in the same way as in the lifting jack and it is similarly attached to the maple. The wheel bolts carry two broad nuts to catch on the rear face of the web or spokes of the wheel. The wheel is shown in dotted lines. This device is often resorted to in removing wheels from gasoline engines. This implement and the lifting jack have been in use four or five years. They have stood lots of wear and apparently are as strong as ever. A greater leverage

on the wheel puller is obtained on the outside bolts with any suitable wrench.

Convenient Flywheel for Gasoline Engines.—Most all the flywheels for small marine gasoline engines are filled up with spokes or webs with few holes in them, which makes it very awkward to get at the eccentric strap and pump to tighten the nuts and stuffing box. Nearly every time this is done the man in charge of the engine uses a cold chisel or screwdriver with a hammer. I have designed a wheel and used it on my engine for four years. It has only two spokes and a hand rim, doing away with the cranking handle, which is a dangerous feature. The plate lying on the floor covers the key as well as the spokes, and is attached with two machine screws.

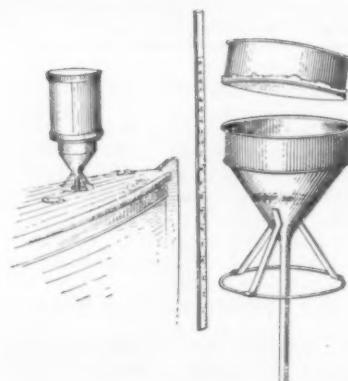
This makes a very tidy looking wheel which is absolutely safe because there is no danger of getting



A CONVENIENT FLYWHEEL.

caught in the spokes. It is a great convenience in cleaning behind the wheel or repainting, as it does not take a minute to remove the cover plate when desired. A wrench is the proper thing to use on the nut instead of a cold chisel. It can be done where this style of wheel is used.

Tunnel for Gasoline.—The tunnel here shown is a practical one. You can capsizes a five gallon can of gasoline and allow it to rest in the tunnel until it is empty, as illustrated in Fig. 1. A breeze of wind will not blow it one side slopping it over, which always happens when trying to pour out of the can into the ordinary tunnel. The practical tunnel has a long piece of $\frac{1}{4}$ -inch tubing which goes well down into the tank



IMPROVED GASOLINE TUNNEL.

and should always be smaller than the receiving hole in the gasoline tank. The supports for the tunnel are made out of galvanized iron 1 inch wide and $1/16$ thick, bending the upper end to conform to the angle of the cone while the lower end is bent around a $3/16$ -inch galvanized wire hoop about ten inches in diameter. A trifle larger than the upper part of the tunnel is good proportion.

This part of the tunnel is a standard article which can readily be procured. The parts that are attached are well soldered. It is not necessary to rivet them. Place a wire gauge about fifty or sixty mesh to the inch inside of the tunnel. If a chamois filter is desired make a band of metal that will easily slip inside of upper part of the tunnel. The lower end of this is covered with chamois, which is held in place with small twine. Tack a strip of vulcanized fiber to the measuring stick.

The graduations of gallons should be marked with lamp black mixed with shellac. The vulcanized fiber turns a sharp and pronounced shade when dipped in gasoline, which is readily seen.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

ATTACHMENT FOR GARMENT-SUPPORTERS.—J. S. MARTIN, New Holland, Pa. The purpose of this invention is to provide an attachment which can be used in place of buttons, and which will cause the supporters to have a central draft on the garment instead of holding the garment up from one of its sides, whereby the garment will be so supported that it will be more comfortable to the wearer and will hang in better shape.

Electrical Devices.

TELEPHONE-TRANSMITTER.—W. WHITEN, Schenectady, N. Y. This invention is adapted for use in connection with heavy currents. It contemplates such a distribution of the carbon granules employed in the transmitter, that the current used may be employed as a slowly pulsating current, a rapidly pulsating or an alternating current, by merely changing the electric connections.

Of Interest to Farmers.

COTTON-BALING PRESS.—E. A. WITHERS, Atlanta, Ga. An object here is to provide a cotton tamper driven by a slow acting power screw, in which the movement of the head is increased, thereby decreasing the time taken in pressing the successive changes, with means for changing the attachment of the head so that the movement of the power screw may be communicated directly to the latter, thereby increasing the power for baling purposes.

EGG CANDLING AND PACKING MACHINE.—H. PEPER, Vehling, Neb. The inventor provides a machine that holds for a short time the eggs being treated in position to be subjected to a light test for decomposition; and provides a machine which will automatically pack eggs in suitable receptacles. The machine is simple in construction and requires the attention of but one operator.

Of General Interest.

CURRENT WATER-WHEEL.—L. LEMERT, Brownstown, Ill. This wheel is of the kind adapted to be set in the side of a bank or at the end of a jetty, so that the working half of the wheel may be exposed to the current. An object of the invention is to form a simple and efficient water wheel, which will utilize the energy in a flowing stream without the necessity of building a dam or the like.

MUSICAL GARDEN ORNAMENT.—A. S. JAKOBSON, New York, N. Y. This ornament is for use in houses and gardens. It is beautiful and attractive to the eye, and produces by the action of gentle breezes thereon, a ringing sound of such ethereal sweetness and such delicacy and variety of tones which will appear to be at a great distance and yet indefinitely near, so that they will produce an almost magical soothsaying effect on the hearers.

PROPELLER-GUARD.—J. L. HAWTHORNE, Paterson, N. J. To overcome the danger of submerged rocks, the inventor has designed a propeller guard which in general consists of a frame extending beneath the propeller shaft and propeller, both the shaft and guard being supported to swing upwardly when the guard strikes an obstruction, thus allowing the propeller to ride safely over.

SCAFFOLD.—H. O. COFFIN, Terre Haute, Ind. In the present patent the invention has reference to scaffolds, and it has for its object the provision of a scaffold which can be quickly erected or dismantled and one which when in position will afford a strong and ready support. All the parts are capable of being quickly packed for transportation.

COMBINED CANE AND CAMP-STOOL.—M. KILLIAN, Elkton, Colo. This folding device can be easily carried about and will serve not only for a seat when unfolded, but may serve as a walking stick or cane when folded. The main folding parts are so arranged that when folded they will fit together so as to make a compact structure without sacrificing in any way the strength of the supporting members.

ANCHORING-BASE FOR POSTS.—P. T. BAILEY, Newport, R. I. The object of this inventor is to provide a base in which there are two sets of anchoring spikes which may be driven into the ground after the base is set in position. The base has means for adjustably supporting a fence post, whereby the post may readily be aligned.

FLASH-LIGHT.—H. A. WHITFIELD, New York, N. Y. In this case the object is to produce a flash-light having improved means for holding and exploding a cartridge or flash powder and further, to provide a construction which will enable the device to be used also for supporting and firing flash papers or flash sheets.

DERRICK DUMPING DEVICE.—C. H. PETERS, H. HART, and S. C. STINECIPPER, Brown Station, N. Y. The device is arranged to permit of tilting the bucket at any time or in whatever position the boom may be in at the time. For this, use is made of a dump drum and a dump line adapted to be wound up or unwound on the drum, the line passing from the drum through a sheave block, swiveled on the lower end of the mast, to then pass over hoisting means on the upper end of the mast and the outer end of the boom, to connect with the bucket to tilt the latter.

Hardware and Tools.

TOOL-HOLDER.—E. RAWSON, Lewiston, Idaho. Means are provided by which the tool may be quickly applied and detached from the holder, consisting of a locking member journaled in the spindle, a clutch, a wrench journaled in the clutch, movable into and out of engagement with the member, and means for moving the clutch to engage and lock the spindle against rotation during the operation of the wrench.

SEAL-HOLDING MECHANISM FOR LOCKS.—C. H. JOHNSON, Petaluma, Cal. This hasp lock has novel details that enable the retention of a paper seal within the lock over the keyhole therein, which, if perforated, or removed after the lid has been closed and secured by the lock, will expose the fraudulent opening of the lock, and receptacle upon which it is mounted.

WRENCH.—H. HAND and T. HAND, Seattle, Wash. This improvement provides a wrench which can be used either as a pipe wrench or for turning nuts. The wrench is self-adjusting from about one-half inch to about a two-inch tap or nut, is so constructed that it has no weak parts to spring or to get out of order, and can be made in different sizes to suit a particular purpose.

INKSTAND.—J. J. HOY, New York, N. Y. The aim of this inventor is to produce an inkstand enabling the ink to be readily accessible to the pen whatever may be the quantity of the ink in the stand, and to provide an arrangement whereby the position of the inkstand can be adjusted to suit the quantity of ink which it contains. Mr. Hoy has invented another stand of the mountain or reservoir type in which he provides means for preventing the overflow cause by numerous and well known difficulties. He also provides means which will facilitate the filling of the reservoir.

Heating and Lighting.

LAMP-SHADE HOLDER.—J. CRUIKSHANK, Shamokin, Pa. This invention relates to improvements in shade holders, and more particularly to a construction for facilitating the attachment of the shade holder to the socket of an incandescent electric light. It avoids the use of screws, bolts, or other similar fastening members, and the necessity of relying entirely upon the resiliency of the metal.

BOILER.—J. G. HAYDEN, New Lexington, Ohio. The aim of the invention is to provide a boiler for use in heating water for dwelling houses and the like, which includes a burner especially adapted for the use of natural gas, which can be easily regulated to insure efficient combustion by means of which water can be readily heated, and which is compact in form.

WATER-HEATER.—A. F. MILLAN, Middletown, W. Va. This heater comprises a stand pipe at the bottom of which any source of heat such as a common burner may be arranged. This pipe is surrounded by a casing at the top and bottom of which water connections are provided for the inlet and outlet of water to be heated. The stand pipe forming the fine of the burner is corrugated freely to provide an increased radiating surface and to divide the water into a series of thin fuses.

Household Utilities.

BED-COVER SUPPORT.—E. D. PEERSTONE, Chicago, Ill. This invention pertains to a device, the purpose of which is to support the covers of a bed at the foot of the bed so as to relieve the feet from the weight of the bedclothes. The device is particularly useful as an attachment to the bed of an invalid, and it is also useful in summer to keep the feet cool.

VENTILATOR.—R. M. HILL, New York, N. Y. This invention relates to ventilators adapted to be detachably secured to the window casing, so that the window may be opened a short distance to permit the entrance or escape of air, and, at the same time, to prevent direct drafts or strong currents, and to prevent the admission of rain, hail, snow, sleet, and foreign bodies.

IRONING-BOARD.—ANNE M. GARMAN, Le Beau, S. D. The intention here is to provide a main frame of clothes-horse, upon which clothes may be hung after ironing, and to this frame attach folding arms, provided with ironing boards and nets, in which the clothes may be placed before ironing. One ironing board may be used for larger pieces such as sheets and table linen, while the other is used for smaller work.

HAIR-CURLER.—W. M. WILLMAN, Mahanoy City, Pa. This invention is for use for curling the hair of women and children. The aim is to produce a device which can be readily applied when in practical use. Instead of making the device of round cross section it may be made angular or square, so as to produce a wave effect in the hair.

Machines and Mechanical Devices.

PIPE-PULLING MACHINE.—C. D. SHORTS, Fern, Pa. The aim of this inventor is to provide a machine having an extensible mast which is adapted to fold down upon the frame of the device, the entire structure being mounted upon wheels, so that it can be readily moved to and from the localities of the oil or artesian wells.

PIANO-CASING.—F. RENK, New York, N. Y. In this instance the improvement refers to pianos, and the aim is to provide a piano

casing, having a mechanism for simultaneously opening or closing the front fall, the back fall, the panel and the top of the piano, on the operator pressing an auxiliary pedal.

COPY-HOLDER.—B. F. PRETS, Moro, Ore. The object of this invention is to provide a copy-holder in which the copy is automatically kept in the operator's sight while at the same time being securely held in a convenient position in such a manner that it cannot be blown about or otherwise disturbed. A further object is to provide a holder which can be readily attached to the standard makes of typewriters without the necessity of dismantling the machine.

FILLING AND CROWNING MACHINE.—L. LITTY, Baton Rouge, La. This machine receives bottles of different heights. Means provide for a charging cylinder to be brought into air-tight engagement with bottles to be filled, and a gaged quantity of liquid to be delivered to the discharging cylinder and thence to the bottle placed to secure it, and while filling, a cap is placed in position to be carried over the mouth of the bottle, and on being filled the cap is carried over the mouth of the bottle and is crimped or clamped to the neck.

FLYING-MACHINE.—L. C. KINCANNON, Seabright, Cal. This machine is of the so-called rotary-wing type. It comprises two or more pairs of wings, each pair being composed of six separate wings. The wings are mounted to revolve about an axis, and also caused to be intermittently rotated, so that for a portion of their travel, they will be in a plane parallel with the general plane or direction of motion of the machine.

FISH-SCREEN.—W. B. ERECKSON, Salt Lake City, Utah. The purpose is to provide a self-cleaning screen for use in hatcheries, irrigating ditches, and any small stream, and so placed and constructed as to effectively prevent fish from passing through the screen and meeting destruction when the water supply is diminished or cut off. It also continually carries moss, leaves, twigs, and all debris over the top of the screen and deposits them in the stream below, thereby preventing the backing up of any debris against the screen.

WASHING-MACHINE.—J. H. BULLOCK, Logan, Utah. Specifically the improvement consists in the provision of a rotatable rubber mounted upon the lid or cover of the tub and adapted to engage the tub supporting standards, so that as the tub is oscillated the rubber is oppositely oscillated, to effect the rubbing or cleansing action between the corrugated tub bottom and the rubber, the latter having a rotatable part which facilitates this action.

WELL-PUMP.—A. N. BLAZER, Mescalero, New Mex. The object of the inventor is to provide a well pump adapted to be lowered into the well to any desired depth, and having spiral intersecting pistons rotating in unison in the intersecting bores of a pump casing, the casing being open at the top and bottom and fitting the well, one of the pistons being driven from above ground so that the pistons named cause the water to be lifted to any height, the water passing through the pump freely, and without spraying, whirling, or abrupt deflection, thereby reducing the friction of the water to a minimum.

CAR-HANDLING MECHANISM.—A. J. LAFAYETTE, Jr., Pittsburg, Kan. This invention provides means whereby loaded cars are automatically run upon an elevator cage used for hoisting in mine or other shafts; provides an automatic mechanism for delivering said cars to the cage, and for releasing any empty cars therefrom which may have been lowered with the cage; and provides a means whereby the functions of the mechanism are performed.

STEAM-TRAP.—G. C. ELLERTON, Portmouth, Va. This invention pertains to improvements in automatic steam traps for the discharge of the accumulated water of condensation. One of the objects is to provide a device in which the accumulated water can be discharged as fast as it enters the trap without the necessity of providing a by-pass.

Prime Movers and Their Accessories.

ENGINE.—P. O. POULSON, Brigham, Utah. Mr. Poulsou utilizes two pistons within each cylinder and so connects these pistons that they will move simultaneously in opposite directions from the center. The pistons instead of being connected to a crank shaft are connected by gears to a pinion on the main shaft, so that the movements of the pistons in opposite directions will simultaneously tend to rotate the shaft in the same direction. It tends to a large extent to eliminate vibration of the engine.

STEAM-ENGINE.—E. GARST, Dayton, Ohio. In the present patent the invention relates to single-cylinder reciprocating steam engines, and the object is to provide a new and improved steam engine, arranged to insure an easy and uniform running under varying loads, and to allow adjusting of the engine according to the work to be done and to cause the engine to run in either a forward or a backward direction.

ROTARY ENGINE.—D. CONEKIN, Tampa, Fla. The object here is to provide an engine wherein a pair of pistons are geared together by means of the blades or vanes intermeshing, wherein the motive fluid is directed squarely against the operative face of the blades, and wherein the fluid will act on the blades with equal facility in either direction.

ENGINE.—J. A. DOWLING, Biloxi, Miss. In this instance the intention is to provide a new and improved engine, in which the motive agent is introduced between two pistons reciprocating in headless cylinders, to utilize the motive agent to the fullest advantage and to allow of compounding the engine in a simple and efficient manner.

INTERNAL-COMBUSTION ENGINE.—L. F. SLEAD, Denver, Colo. The object of the present invention is to provide an internal combustion engine, more especially designed for use in tunneling and other machines, with a view to cause a cutting tool to deliver or strike blows on rocks or other material, without injury to the operating parts of the engine.

Railways and Their Accessories.

SIGNAL.—C. P. RUGGLES, Sedalia, Mo. This invention relates more particularly to such signals as are adapted to be used in connection with the operation of railroads, and which consist of casings having compartments, and spring-actuated, sectional targets arranged within the compartments, the former being adapted to assume an extended position for display when released from the compartments.

MAIL-BAG CATCHER.—J. A. SCHINNER, Greenfield, Ohio. The purpose here is to provide details of construction for a mail-bag catcher that adapt it for reliable service either to catch a mail-bag and deliver it at the open door of a mail-car on a moving train, or to transact a mail-bag from a train in motion to a station at the side of the track on which the train is moving.

RAILROAD-RAIL JOINT.—H. NARLEFIELD, Monico, Wis. This invention refers to means for connecting together the meeting ends of rails, and the purpose is to provide novel details of construction for the track rails of a railroad, which will effect a proper alignment of the rails and compensate for their expansion and contraction due to exposure to heat and cold.

CAR-FENDER.—J. T. CARRIBER, Heath, Mass. An object of this invention is to provide a car fender having a movable portion, so that when a person is struck by the fender, the movable part will operate to close the space between the ground and the normal position of the fender, thereby preventing the fender from riding over the person and also serving as a protection to the wheels.

GRAIN-CAR DOOR.—J. E. FAUCETT, Kenmare, N. D. The main object of this improvement is to provide a door which may be easily opened after the car has been filled with grain, notwithstanding the pressure exerted by the grain itself. In fact, the pressure of the grain upon the door facilitates the opening of the latter.

REFRIGERATING-CAR.—J. THORNTON and E. HEYMANS, New York, N. Y. The invention contemplates the use of refrigeration apparatus, such as ammonia machinery, in which the cooling water for the condenser is kept at a sufficiently reduced temperature to do this work, by a special construction and arrangement of the tank in which it is normally held, so that the surface of the tank is exposed to the rush of air developed by the motion of the car.

RAIL-JOINT.—W. H. FRENCH, Evansville, Ind. In constructing this joint by which the jarring incident to the hammering of the wheels is substantially eliminated, the adjacent ends of the rails are provided with a common transverse opening or slot in which are placed two curved plates, with the concave faces of the plates facing inwardly, and means tending to flatten and expand the plates to bind against the upper and lower edges of the opening.

WRECK-PREVENTER.—E. B. POOLS, Delmar, Ala. In the present patent the object of the improvement is the provision of a device capable of being attached to any locomotive or railroad car, and which will grasp a third rail beneath the tread, thus effectually preventing the wheels from leaving the track.

Pertaining to Recreation.

CUE.—H. McCLEARY, Washington, D. C. This invention is an improvement in cues for use in playing billiards and similar games and particularly in the tip holding devices for use on said cues. The construction is simple, inexpensive, facilitates the application and removal of the cue tip, and enables the substitution of a new tip instantly and without the aid of skilled labor.

TOY PISTOL.—M. J. SHIMER, Bethlehem, Pa. In this automatic pistol caps in the form of tape are fed under the hammer at each pull of the trigger and means retain the hammer and cap-feeding finger in position to enable ready insertion of the tape over the feeding plate and anvil when the tape is renewed. Means lock and unlock a cap chamber cover on its seat, and return the hammer and the finger named when released and press it to the feeding plate by means of a single spring.

CONTAINER FOR FISHING APPARATUS.—J. M. ELLSWORTH, Bernardsville, N. J. This invention involves an improved container for use in carrying flies and their attached leaders used in fishing, and the object of the invention is to so construct the container that the flies will remain dry while the leaders and the connections between the leaders and flies will remain moist.

Pertaining to Vehicles.

SPRING WHEEL.—A. R. MISKIN, Idaho Falls, Idaho. This inventor has for his object the provision of a wheel wherein the hoop or rim of the wheel itself is resilient or pliable so as to act in the capacity of a spring. In this way, the jars and jolts are taken up by the spring rim of the wheel and no other springs are necessary.

WRENCH.—J. F. PONTIUS, Hot Springs, Ark. This invention is an improvement in wrenches. The wrench is especially designed for use in wagons for the wheel nut and efficiently serves the purpose for which it is designed. The cross bolt has a squared portion adjacent to its head and the opening receiving the said square portion is correspondingly formed to prevent the turning of the bolt.

AUTOMOBILE STARTER.—C. A. SMITH, Brattleboro, Vt. The invention relates to starting devices for automobiles, by means of which the regular starting crank, as commonly used, may be dispensed with, and the device may be operated by the driver without leaving his seat. The pedal may be locked in position by a latch, which can be released only by retarding the spark lever to the proper point for cranking the engine.

ROAD-SMOOTHING DEVICE.—F. W. LECHNER, Wenona, Ill. The device is adapted to be drawn over wagon roads, or by attaching them to ordinary vehicles or to vehicles especially designed for the purpose. This type was shown in a prior patent granted to Mr. Lechner. An object of the present patent is to provide a device which may be adjusted angularly to direct the dirt toward the center or toward the side of the road.

BRAKE-CONTROLLING DEVICE FOR BICYCLES.—B. PECUASSE, Lyon, France. The device enables the rider to produce a graduated pressure of the friction brake upon the tire, and thus control with ease the progressive movement of the wheel when coasting; and further the device is constructed so that slackness in the brake-setting cable can be taken up at any time by an adjustment of parts, and thus maintain the brake in proper condition for effective operation.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th, 1909, or will be sent by mail on request.

(12211) C. W. O. asks: I have a question that I wish you would answer through your paper. Where does the induction come in when you are standing at your telephone, and can hear folks talking on other lines and from other towns? One can hear this when the lines run in opposite directions. The telephone companies here claim that it is the wires running along side by side for some distance, when in this case the sound of words spoken jumps across from one wire to the other. Now what I think about it is that it is at the central station. I notice at these places that they sometimes have put one ground wire, to which they hitch all the lines that come into town. I hold the ground that this is where the most induction comes in. Am I right? Can this induction be heard if every line entering central had a grounding of its own before entering? Does it weaken a telephone system to be able to hear the talk at the same time all over the country? A. The cross talk in the telephone is ordinarily caused by the induction of electric currents flowing in wires near to the wire to which your telephone is connected. No sounds flow over the wires. Only electric currents pass from telephone to telephone. These cause a vibration of the receiver, which you hear as a sound. These currents pulsate as waves around the wire which is transmitting them. These waves are very much like the waves which are used in wireless telegraphy, but are less intense. They can, however, affect a wire quite a number of feet away, and cause a person to hear in his telephone what they are carrying to their own telephone. The process of thus affecting a wire with which the current has no direct connection is called induction. It is not necessary to call the ground wires into the case to explain the action. Such currents do not injure the instruments at all. They are very annoying when they mix up with what one is saying and prevent distinct hearing. They are prevented by the use of a metallic return circuit of twisted wire, as is done in all cities and large places.

(12212) F. E. W. asks: I desire to purchase a reliable hygrometer for indoor and outdoor use. What make of hygrometer would you recommend, and where can it be purchased? A. All the so-called hygrometers are simply indicators, and are not scientific instruments, giving a measurement of the humidity of the air. The instrument employed in the Weather Bureau consists of two thermometers on the same base, one having water constantly evaporating from its bulb, and the other having a dry bulb. These you can get through the Weather Bureau, Washington, D. C., and from tables you can determine the humidity correctly. They will not cost much more than the so-called hygrometers, and are reliable.

(12213) C. C. asks: If an air-tight tank one cubic foot square, made of material the same weight as water, were submerged to a depth of fifty feet in still water, what would be the pressure of the water on the two top sides, the two bottom sides, and the two ends, separately, the tank to sit with one edge up? What would be the pressure of the tank upward if released, and would the pressure diminish any, the nearer it came to the surface? If so, at what rate? If you turn the tank flat on its side, would the pressure upward be as great? If not, how much difference? A. If a box one foot on a side is sunk in water, it displaces one cubic foot of water. Each side is a square foot. At a depth of fifty feet each side is pressed upon by a column of water one foot square and fifty feet high, which weighs about 50×62.5 pounds. As there are six sides, the total pressure on the box is six times the pressure on one side. It makes no difference how the box lies in the water, since the pressure under water is equal in all directions and perpendicular to any surface. The upward pressure of the water is greater than the downward pressure of the water by the weight of the water displaced, which is the weight of one cubic foot of water. This for fresh water is about 62.5 pounds and does not vary with the depth. Now if the box is of the same weight as water it will not tend to rise or sink at all, but will remain at any depth at which it may be placed. This is in accordance with Archimedes' principle, which is given in all text-books of physics.

(12214) D. R. asks: Will you kindly explain in inquiry column how the moon can complete one rotation on its axis in the same time that it makes a circuit of its orbit, all the while presenting the same hemisphere to the earth? I can readily understand it faces the four cardinal points of space in its circuit, but fail to see any indication of axial movement. A. Whether one considers that the moon rotates on its axis or not depends upon the point of view. As seen from the center of the earth, it does not rotate on its axis; as seen from the sun, it does. Astronomers are agreed in considering the matter as if viewed from the sun, and all astronomers state that the moon rotates once in a revolution. It presents all points of its surface toward the sun each month. The moon really revolves around the sun in company with the earth. Its orbit is always concave to the sun, and moon and earth swing to and fro as they go, the center of gravity of the two moving around the sun in the ellipse which we speak of as the earth's orbit. You will find this in almost any astronomy. See Todd's "New Astronomy." If you will try a lamp and a globe as described in Todd's book, you will see that you must turn the globe on its axis in order to keep it with the same face toward the lamp in the center, as you carry it around the lamp.

(12215) R. S. asks: I am going to install electric lights in my farm home and use water power. I have a stream near my house that by damming I can get a fall of 10 feet. It has a flow of 125 feet a minute and will run a 6-inch pipe full and a little to spare, the year round. I have been told that it will furnish about 4-horse-power, and I believe that it would be an ideal power for lighting my home, a house of ten rooms. I am going to buy a direct-current dynamo and the wires, etc., and wish to make my own water wheel. I inclose 40 cents, for which please send me four of your SUPPLEMENTS which, in your opinion, would be useful to me in making an overshot water wheel or a turbine. I am in a position to make either kind, for I have a workshop of my own. I am going to use a $1\frac{1}{2}$ -kilowatt generator and about 30-32 candle-power tungsten light. You may use your own judgment in selecting these SUPPLEMENTS for me, knowing that you have had numerous calls like mine. Anything that will be of information to me will be thankfully received. A. We would advise that it is necessary to allow 1.7-horse-power per kilowatt in small plants, so that your 1.5-kilowatt generator should have about 2.5-horse-power in the water wheel to drive it. The 32-candle-power tungsten lamps require 40 watts each, and thirty of these lamps will require 1,200 watts, which will call for a little more than 2-horse-power at the water wheel. If you will not require all the lamps at one time, it may be that you can get along with 1-horse-power at the water wheel. You should, therefore, have ample power, even if we understand you correctly that the flow of the stream is only 125 cubic feet per minute. That quantity of water with a 10-foot fall will generate theoretically 2.37-horse-power, of which you should be able to obtain 30 per cent, or better, in actual useful work with an efficient Pelton or similar water wheel. From your remark, however, that the flow is sufficient to keep a 6-inch pipe running full, we should say that

you probably have more power. One hundred and twenty-five cubic feet per minute represents the flow through a 6-inch pipe with a fall of less than 1 in 10, and if your pipe was placed with a sharper fall when you made the measurement, the flow may be greater than you suppose. If the pipe was placed with a fall of say 1 in 2, and ran full, the flow would be nearly 300 cubic feet per minute, giving you more than twice as much power, or if it ran full with a fall of 1 in 1, over three times the power.

(12216) C. W. S. asks: Will you please answer the following questions: 1. What metal or metal alloy has the lowest melting point? A. You will find a long list of fusible alloys in Kent's "Mechanical Engineer's Pocket Book," which we send for \$5 post paid. The one having the lowest melting point as given there is Darcey's with mercury. It is made of bismuth 50, lead 25, tin 25, mercury 250 parts, and is said to melt at 113 deg. F. Wood's alloy is made up of bismuth 50, lead 25, tin 12.5, cadmium 12.5 parts, and is said to melt at 149 deg. F. 2. Have any estimations been made recently on the speed of light, and also electricity? I saw in a certain paper a statement to the effect that light travels 192,000 miles per second, and electricity 288,000, whereas I always thought they both traveled 186,500 miles per second. A. The speed of light and electricity through space is 186,300 miles. The best measurements are those of Michelson and Newcomb, described in our SUPPLEMENT, No. 557, price 10 cents. You are correct in your idea that the two, light and electricity, come together from the sun. The number you quote, 288,000 miles, was given a good many years ago, and was due to erroneous ideas about the matter.

(12217) T. H. says: Suppose the moon to be 240,000 miles from the earth, in round numbers. Its orbit will then be 720,000 miles. The diameter of the moon being 2,000 miles, it would require 360 moons in contact side by side to extend around the complete circle of the orbit. Now, as there are 360 degrees in a circle, and 360 moons in contact would extend around the moon's orbit, why does it not follow that a diameter of 2,000 miles at a distance of 240,000 miles is just one degree? The astronomers say the moon really is from 28 min. to 33 min., or about $\frac{1}{2}$ of one degree. I had as well say that I am aware that the moon is something over 238,000 miles away, is over 2,100 miles in diameter, that its orbit is an ellipse, and that PI is not exactly 3 to 1. I have given round numbers for convenience. A. If the data regarding the moon were as you give them, the results would be as you calculate; but since the data are not as you give them, the results are too far from the actual to be of any value. The moon varies in its distance from the earth from 221,600 miles to 252,970 miles. The circumference of her orbit cannot then be calculated in terms of a circle. The mean diameter of the moon is 31 min. 8 sec., and this varies more than 2 min. This is found by direct measurement by astronomers with the micrometer eyepiece of the telescope. That is first-hand data. The moon's diameter in miles is 2,153, quite too much more than 2,000 miles to be put into round numbers in that way as a basis of a "Why does it not follow?" It would follow, as we said above, if it were so.

(12218) E. E. K. says: After consideration as to whom I could apply, I shall trespass upon your time to ask if no legal responsibility would attach to discomfort or danger, through a passageway being "sealed up" (virtually) in a water-tight compartment on an ocean steamer. Fortunately, I have no personal complaint of such to make, but my attention was called to it last year, when some passengers found themselves so shut up at night, one of them (ladies) being ill. In this case they found a rambling exit up a small back stairway, and so emerged through the large dining room. Upon further consideration of the matter I scarcely think I am mistaken in supposing that some of these compartments with nine or twelve staterooms are completely cut off, even first-class passengers. In the case of steerage I do not suppose life would be worth considering. I heard of one instance where a gentleman upon going down late found the only way to his berth through the ladder on the smokestack. In view of the awful possibilities and of the great stress laid upon free exits on land, this appears to me an important issue. A. Correspondents should observe the rule that street address, names of cities and States should be given in full, as otherwise it causes us much trouble. Your question is a peculiar one. Most of the modern bulkhead doors are kept normally open, and are only closed hydraulically or electrically when there is an accident, such as a collision or stranding. There are bulkhead doors above the water line which are to be closed by stowards in case of emergency. It is impossible to give any exact answer to your letter without knowing the boat. The mutilated diagram showing ship's cabins would not indicate that there were any bulkheads which were normally to be kept closed, although there appear to be several fire bulkheads for use above the water line. These doors would be kept normally open. We do not think you are well informed in stating that nine to twelve staterooms would be entirely cut off without access to a companionway. Great attention is paid to the life of every passenger at sea, as will be seen in an

important book which will shortly be issued, entitled the "Scientific American Hand Book of Travel," in which some thirty to forty pages are devoted to "Safety at Sea." One is as safe at sea as in a trolley car or railway car in this country. The writer is entirely familiar with steamers of all classes which are licensed to carry passengers, and he is unacquainted with any such condition as you outline.

NEW BOOKS, ETC.

THE HUMAN RACE. Its Past, Present, and Probable Future. An essay by J. Samuelson. London: Swan Sonnenschein & Co., Ltd., 1910. Pp. xi + 192.

In the preface to his book Mr. Samuelson states that his aim has been "the embodiment of the experiences and results of an octogenarian." He outlines briefly the changes which have taken place in the nature, belief, and activities of mankind from the earliest period down to the present day. If the book has any fault, it is that of dwelling too much upon the emotional, physical, and intellectual man. The few references to inventions to be found under the heading of "Man's Mental Progress" can hardly be considered so much an evidence of heightened mentality as of improvements in exterior conditions. The improvement of exterior conditions does not necessarily mean development of the intellect. The later phases of evolution and their influence upon mankind are not discussed, though it cannot but be admitted by every thinking man that the revival of Mendel's law of heredity and its application, as well as the modern views of eugenics, undoubtedly have their bearing upon this subject. On the whole, however, the book must certainly serve the purpose for which it was written, namely, that of "stimulating inquiry and serious study."

TASCHENBUCH DER KRIEGSFLOTEN. Mit einem Anhange: Die Luftkriegsschiffe. XI. Jahrgang 1910. Herausgegeben von Kapitänleutnant a. D. B. Weyer. München: J. F. Lehmanns Verlag. Price, \$1.50.

Capt. Weyer's excellent handbook follows the general arrangement of his previous annuals. The remarkable development in the English, German and American fleets during 1909 are all accurately calculated. The most novel feature of this year's handbook is an illustrated appendix on the developments of aeronautics in 1909, particularly with reference to the military and naval value of aero-locomotion.

INDIAN INSECT LIFE. By H. Maxwell-Lefroy, M.A., F.E.S., F.Z.S., assisted by F. M. Howlett, B.A., F.E.S. Calcutta and Simla: Thacker, Spink & Co., London: W. Thacker & Co., 1909. 4to.; 786 pp.

This is a manual of the insects of the plains of tropical India. It is beautifully illustrated and is a rather remarkable production to be printed in Calcutta. The subject is rather a special one, and we do not feel competent to pass an opinion on it. The work seems to be a thoroughly scientific one and the plates are certainly very creditable. They are numerous and well executed.

LIGHT. By Richard C. MacLaurin, President of the Massachusetts Institute of Technology. New York: Published by the Columbia University Press, 1909. Price, \$1.50.

During the winter of 1908-9 Dr. MacLaurin delivered a series of ten lectures before the American Museum of Natural History on the salient features of the modern theory of light. Written primarily for the intelligent man who lays no claim to scientific knowledge, but wishes to keep abreast of the scientific times, this book serves admirably to show how wonderfully the modern theories suit the facts down to the minutest numerical detail. The subjects treated are the following: Early Contributions to Optical Theory, Color Vision and Color Photography, Dispersion and Absorption, Spectroscopy, Polarization, The Laws of Reflection and Refraction, The Principle of Interference, Crystals, Diffraction, and Light and Electricity.

RADFORD'S GARAGES AND HOW TO BUILD THEM. Selected and compiled by William A. Radford. Chicago and New York: The Radford Architectural Company, 1910. Pp. 108; 55 designs. Price, \$1.

This collection of garage designs contains many new, original, and artistic examples of up-to-date private and public structures for the housing of automobiles, and permits considerable latitude in the choice of material to be used in the construction. The various designs include the use of wood, brick, stone, cement, stucco, and concrete. The compiler, as president of the Radford Architectural Company of Chicago, and the author of various books on architecture and building, is well qualified for the work he has undertaken in the present volume. Many of the designs are of pleasing architectural novelty and are adapted to the various requirements of up-to-date construction, and the latest approved materials used in modern building practice. Nearly sixty different garage designs are illustrated, and the constructive cost ranges from \$400 to \$2,000 for every passenger at sea, as will be seen in an

the larger private garages; while the public buildings of this kind, equipped with the latest approved modern accessories and conveniences, run in cost from \$3,000 to \$11,000.

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HIGH FREQUENCY ELECTRIC CURRENTS IN MEDICINE AND DENTISTRY. Their Nature and Actions and Simplified Uses in External Treatments. By S. H. Monell, M.D. New York: William R. Jenkins Company, 1910. 8vo.; 465 pp.; 23 plates. Price, \$4 net.

The author describes in detail how he has used high-frequency currents in medical treatment and dentistry, explaining in detail how he applies the treatment for specific ailments.

PRACTICAL ARMATURE AND MAGNET WINDING. By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Co., 1909. 16mo.; 231 pp.; 128 illustrations. Price, \$1.50.

This book is intended for the practical electrician and aims to supply sufficient information about the theory of armature winding to enable him to understand the advantages of certain methods employed in actual practice and the necessity of certain precautions. The authors have aimed to eliminate all irrelevant matter and adhere closely to their motto to supply "everything that is needed and nothing that is not needed."

THE CALCULUS AND ITS APPLICATION. By Robert Gordon Blaine, M.E. New York: D. Van Nostrand Company, 1909. 12mo.; 321 pp. Price, \$1.50 net.

The use of the calculus has come to be of such importance in engineering work and particularly in electrical work that it is necessary for many who were unable to take up this subject in college days to study calculus by themselves. The present work is well adapted to home study as it is written in a very clear style, the various steps being explained thoroughly and illustrated with examples. The book is primarily intended as a textbook for school use and is compiled from notes and examples prepared by the author for his own classes.

ON PFLANZEN ZWISCHEN DORF UND TRIFT. Von Dr. Ad. Koelsch. Stuttgart: Kosmos, Gesellschaft der Naturfreunde, Geschäftsstelle Franckh'sche Verlagsbuchhandlung. Pp. 93. Price, 50 cents.

INDEX OF INVENTIONS
For which Letters Patent of the
United States were Issued
for the Week Ending
March 22, 1910.

[See note at end of list about copies of these patents.]

Acid, apparatus for the production of acetic, M. J. & B. R. Lyter. 952,540
Aerial transportation, E. Lugo-Vina. 952,539
Air blast extinguisher, W. H. Hendryx. 952,538
Air brake system, B. Farmer. 952,784
Air compressor, E. F. Balbundt. 952,798
Air, device for applying compressed, L. Gall. 952,799
Alarm apparatus, F. Pease. 952,710
Ammonium sulfate from gases, obtaining, A. B. Karr. 952,673
Amusement device, G. A. Bosquist. 952,843
Antimony compounds, making, F. Boeszeck. 952,704
Armor plate, J. A. Zeman. 952,839
Automobile body, convertible, H. E. Olds. 952,575
Automobile emergency brake, M. A. Wagner. 952,821
Automobiles, non-skidding device and clutch for, F. A. Schmid. 952,812
Bags, means for attaching, valve strips to, F. E. Beam. 952,782
Bar, See Harvester cutter bar.
Bearing, roller, H. C. Berry. 952,667
Bed, invalid, W. H. Sterling. 952,652
Bed, mounting, shifting, C. H. Becker. 952,730
Billiard cue tip, A. L. Buckland. 952,600
Binder, pamphlet, E. A. Sharp. 952,471
Binder, pressed steel ledger, L. R. Dicker-
son. 952,668
Binding hinge, loose leaf, A. S. Robertson. 952,642
Blower, means for separating water from steam in steam, Mills & Irvine. 952,831
Book, manifolding, H. L. Rice. 952,638
Book rack, E. Oldenbush. 952,830
Bottle stopper, C. A. Natt. 952,688
Bow for apparel, C. S. Clinch. 952,726
Braiding and knitting and nailing form, H. B. Walter. 952,968
Boxes, form for holding, H. B. Walter. 952,967
Brad holder and set, A. G. Lamb. 952,571
Braiding and plaiting machine, F. A. Schmidt. 952,650
Brake beams and bolsters, beam for, A. P. Kieser. 952,581
Brake broad and close, C. H. Williams, Jr. 952,553
Brake mechanism, R. M. Downey. 952,514
Brake operating mechanism, J. A. & J. A. Schneidhardt, Sr. and Jr. 952,759
Breeding box, stock, O. C. Black. 952,500
Brick making machine, J. H. Dyett. 952,796
Bridge, lift, Waddell & Harrington. 952,486
Bridge, D. C. Jackson. 952,610
Bricket machine, E. Fernholz. 952,960
Brush and holder, shaving, W. C. Dickinson. 952,884
Boxes, crates, etc., corner fastening device for, Coffey & Bowen. 952,785
Bucket, bottom dump, G. Focht. 952,894
Bucket, sanitary, P. Krummert. 952,773
Bucket, double rim, types & Foschier. 952,712
Building block, G. F. Mann. 952,918
Building block tie, Crocker & Tappan. 952,978
Burner, See Wick blue flame burner. 952,573
Cabinet, M. M. & L. S. Munger. 952,505
Cameras, multiplying back for, J. Goddard. 953,005
Candle holder and candlestick, G. C. Nott. 952,905
Candlestick, A. B. Sharp. 952,844
Cane, hemispherical sealing stopper for, L. Sturgis. 952,717

convertors and synchronous motors; also single phase railway motors. There are four chapters on direct current motors and generators. Altogether the book will be found most useful to the practical man as well as the student.

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Properties of Polonium.

BY PROF. E. RUTHERFORD.

Polonium was the first of the active substances separated from pitchblende residues by Mme. Curie. Various methods of concentration were devised by her, with the result that preparations of polonium mixed with bismuth were early obtained many thousand times more active than uranium. Marckwald later separated from 15 tons of pitchblende about 3 milligrams of intensely active material which he called radio-tellurium, since it was separated initially with tellurium as an impurity. By dipping a copper plate into a solution of this substance, he obtained a deposit of weight not more than 1/100 milligram, which was far more active than an equal weight of radium. It was soon recognized that this preparation was identical with polonium, for it gave off the typical a radiation, and had the characteristic rate of decay of that substance. Unfortunately, Marckwald was not aware at the time of separation of the great importance of testing whether lead appeared as a product of transformation of polonium. Before such an experiment could be made, the polonium had to a large extent been transformed.

Polonium is one of the numerous transition elements produced during the transformation of the uranium-radium series. It is half-transformed in about 140 days, emitting a particles during the process. Rutherford showed in 1904 that polonium was in reality a transformation product of radium itself. Radium at first changes into the emanation, and then successively into radium A, B, C, D, E, F, radium F being identical in all respects with the polonium directly separated from a radio-active mineral. When the radium emanation is allowed to decay in a sealed glass tube, the walls of the tube are coated with an invisible deposit of pure radium D, radium E, and radium F, but the amount of the last to be obtained in this way is far too small to be weighable.

The amount of polonium present in any radio-active mineral can easily be calculated. Since the radium and polonium (radium F) in a mineral are in radio-active equilibrium, the same number of a particles are expelled from each per second. Since polonium is half transformed in 140 days and radium in 2,000 years, the former breaks up 5,000 times faster than the latter. The maximum amount of polonium to be obtained from a mineral is in consequence only 1/5,000 of the amount of radium. In 1,000 kilograms of pitchblende containing 50 per cent of uranium, there are present 170 milligrams of radium. The weight of polonium is about 1/5,000 of this, or about 1/30 milligramme. It is thus obvious that to obtain 1/10 of a milligramme of pure polonium, several tons of high-grade pitchblende must be worked up. The most natural source of polonium is radium D (radio-lead), which grows polonium and has a period of half transformation of about twenty years. Since polonium breaks up about 5,000 times faster than radium, its activity, weight for weight, should be about 5,000 times greater than that of radium. There is nothing surprising in this, for the radium emanation has an activity about 200,000 times that of radium, while radium A (period three minutes) must have an activity 400 million times that of radium itself. Since the radiation from polonium is entirely in the form of a rays, it is to be expected that the radiation from it would show chemical and physical effects identical with those observed for pure emanation, the only difference being that the products of the latter emit β and γ rays as well.

Apart from the interest of obtaining a weighable quantity of polonium in a pure state, the real importance of the present investigations of Mme. Curie lies in the probable solution of the question of the nature of the substance into which the polonium is transformed. This problem has been much discussed in recent

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years. Since polonium emits α particles, one of its products of decomposition, as for all the other α -ray products, should be helium. The production of helium from a preparation of polonium has been observed by Rutherford and Boltwood (Manchester Lit. and Phil. Society, November 30th, 1909), and also by Mme. Curie and Debierne in their present experiments. Boltwood several years ago suggested that the end product of the radium series was lead, and has collected strong evidence in support of this view by comparing the amount of helium and lead in old radio-active minerals. Since polonium is the last of the active products observed in the radium series, it is to be expected that polonium should be transformed into helium and lead, one atom of polonium producing one atom of helium and one atom of lead. This point of view receives additional weight from consideration of the atomic weight to be expected for the end product of radium. Since in the uranium-radium series, seven particles, each of which is an atom of helium of atomic weight four, are successively expelled before radium F is reached, the atomic weight of polonium should be $7 \times 4 = 28$ units less than uranium (atomic weight 238.5). This gives an atomic weight of polonium of 210.5, and after the loss of an α particle, a final product of atomic weight 206.5—a value very close to the atomic weight of lead.

It is a matter of very great interest and importance to settle definitely whether polonium changes into lead. The evidence as a whole has long been in favor of that supposition. The outlook is very promising that the experiments of Mme. Curie and Debierne will settle this question conclusively. No doubt an interval must elapse to allow the polonium to decay before the final examination of the residual substance can be made.—Nature.

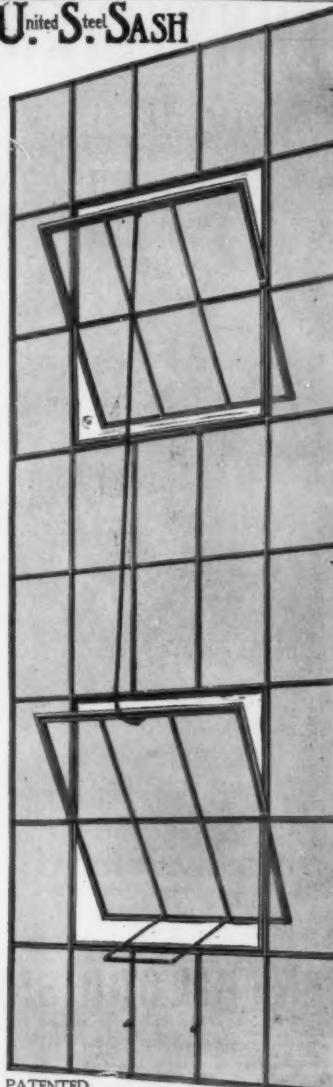
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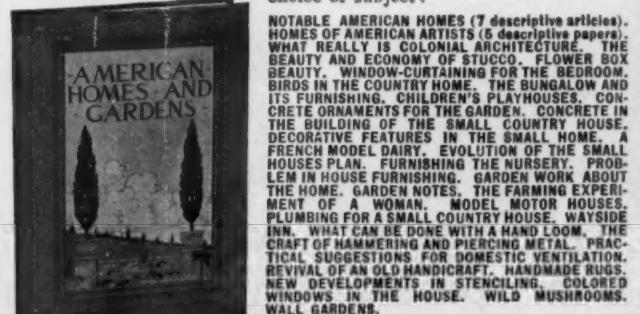
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Spark arrester and smoke consumer, J. E. H. Hart	952,787
Spark coil, C. H. Thomas	952,692
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Spring, machine for assembling and screening, L. A. Chaffee	952,512
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Spray device, C. Revalliot	952,947
Sprinklers, power set for automatic, E. A. Rix	952,646
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Stacker, hay, F. Wyatt	952,490
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Stamp, dating, B. B. Hill	952,738
Stamp, time, F. Purdy	952,577
Stand, See Emery wheel stand.	
Starting gear for sports, W. H. Brenner	952,503
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Steam trap, W. B. Tompston	952,489
Steam trap, Keting & Brown	952,814
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Strap hanger, passenger, W. B. McCarthy	952,927
Submarine, automatic depth regulating device for flying, G. O. Conon	952,452
Suction supporting device, C. A. Austin	952,495
Telegraphic circuits, apparatus for transmitting signals over, L. M. Potts	952,044
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Teaching machine, J. Ongurien	952,838
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Threshing machine feeder, F. Hamachek	952,520
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Trowel, W. G. & D. D. Dugan	952,971
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Truck, herald, F. P. Lockhart	952,013
Turbine, R. H. Goldsborough	952,702
Turbine, elastic fluid, R. N. Ehrhart	952,016
Turbine, elastic, steam, E. F. Edgar	952,791
Type bar and typographic form, F. H. Richards	952,579
Type casting and casting machine, [for] letter spacing mechanism for, F. H. Thompson	952,639
Type mold, Bancroft & Knight	952,693
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Typewriter, J. L. McEntee	952,543
Typewriter machine, Morris & Pomeroy	952,467
Typewriter machine, C. W. Walker	952,771
Umbrella, E. F. Brunello	952,504
Umbrella, F. D. Philip	952,630
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Valve, J. G. Talmage	952,691
Valve, N. H. Suren	952,768
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Valve, throttle, E. D. Caldwell	952,598
Valve, throttle, J. S. Chambers	952,510
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Vending machine coin controlled mechanism, B. Lovatt	952,537
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Wagon boiler washer, J. Y. Martin	952,748
Warm air furnace, C. E. Stewart	952,476
Washer. See the plate washer.	
Washing machine, F. W. Kranz	952,818
Washing machines, clothes powder for, W. J. Bissell	952,641
Watch, C. H. Meylan	952,921
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Welding apparatus, automatic, A. Sonander	952,757
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